Environmental Assessment

Madison Junction / Norris Junction Road Improvement

YELLOWSTONE

National Park • Wyoming / Montana / Idaho

Environmental Assessment

February 1999

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United States Department of the Interior • National Park Service • Denver Service Center

SUMMARY

The segment of Grand Loop Road from Madison Junction to Norris Junction in Yellowstone National Park is in an advanced state of deterioration, primarily due to age. The pavement is rutted from wear and cracking because of poor drainage, poor-quality base material, thermal activity, and increasingly heavy vehicle use. The pavement edge has broken down resulting in an inconsistent 6.7 to 7.4 meter (22 to 24 foot) width. The road was not designed or constructed to accommodate current traffic volumes, vehicle widths, lengths, and weights. Safety hazards include narrow pavement width, inadequate visibility at pullouts and intersections, steep side slopes, poor road surface, rockfalls, and curve alignments that do not meet modern engineering safety standards. A transportation analysis (BRW, Inc. 1998) was completed that concluded that this road segment affords no opportunity for slow vehicles to pull out of the traffic stream to allow other vehicles to see the road ahead and pass. The report further summarized that the narrow width and winding alignment of this road result in poor operating conditions. This in conjunction with the volume of traffic result in a level of service reflecting very congested flow with a high probability of long delays to road users.

Improvement of 16.3 kilometers (10 miles) of the Madison Junction/Norris Junction segment is proposed. This would take place in several construction phases over a period of four to six years if funding is available. Alternative A (preferred) would reconstruct the road and associated parking areas and pullouts. The road would be widened to 9.2 meters (30 feet) with 3.4-meter (11-foot) lanes and 1.2-meter (4-foot) paved shoulders. The road would be realigned between Gibbon Falls and Tanker Curve, following an upland route above the canyon. This would require the construction of a new bridge, removal of one existing bridge, and obliteration of 2.9 kilometers (1.8 miles) of existing road along the Gibbon River. Two historic bridges would be retained and their decks would be widened to accommodate the new road width. Alternative B would also reconstruct the road, parking areas, and pullouts. A road width of 7.4 meters (24 feet) would be built along the existing alignment. In both alternatives, problems such as rockfall, poor drainage, inadequate or inappropriate parking, and standard design deficiencies would be corrected. Appropriate mitigation actions would be incorporated in construction design and documents. Alternative C (no action) would continue existing road maintenance. No major road reconstruction work would occur, and the severe pavement deficiencies and safety hazards would remain.

Under Alternative A, about 28 hectares (70 acres) of soils and vegetation would be disturbed. About 0.96 hectare (2.4 acres) of wetlands and 0.1 hectare (0.3 acres) of thermally influenced areas are included in the total disturbance. Impacts to thermal features would be avoided or minimized with some areas being rehabilitated, and wetland mitigation would ensure no net loss of wetlands. About 1.9 hectares (4.8 acres) of existing roadway would be returned to natural conditions. In Alternative B, 24 hectares (59 acres) of soils and vegetation would be disturbed. About 1.1 hectare (2.8 acres) of wetlands and 0.2 hectare (0.5 acres) of thermally influenced areas are included in the total disturbance for Alternative B. Wildlife, including threatened, endangered, and candidate species, would be protected through construction stipulations and mitigating measures included in construction contracts.

Cultural resources within the areas potentially affected by construction (APE) have been inventoried and their eligibility for inclusion on the National Register of Historic Places (National Register) evaluated. (Additional inventory and evaluation of the Artists Paint Pot area will occur prior to construction). Seven sites have been identified, including the Grand Loop Road Historic District. Six of these properties are eligible for the National Register. The 1994 (as amended) programmatic agreement among the Wyoming and Montana State Historic Preservation Officers (SHPOs), the Advisory Council on Historic Preservation (ACHP), and the National Park Service (NPS) provides direction for the preservation and protection of these properties. Through project planning and design, impacts on most of these properties would be avoided. Where impacts could not be avoided, appropriate mitigation strategies would be developed, and mitigation plans would be prepared in consultation with the Wyoming SHPO and ACHP to prevent adverse effects. To provide mitigation for the adverse effects of the Tanker Curve realignment, a memorandum of agreement is being developed among the NPS, ACHP, and the Wyoming SHPO.

Yellowstone visitors would be inconvenienced by traffic delays and road closures during construction. In the long term, road improvements would provide safer and more enjoyable driving experiences for visitors.

This environmental assessment will be on public review for 60 days. Please address your comments to:

Superintendent
Attn: Planning and Compliance
Madison to Norris Road Improvement
P.O. Box 168
Yellowstone National Park, WY 82190

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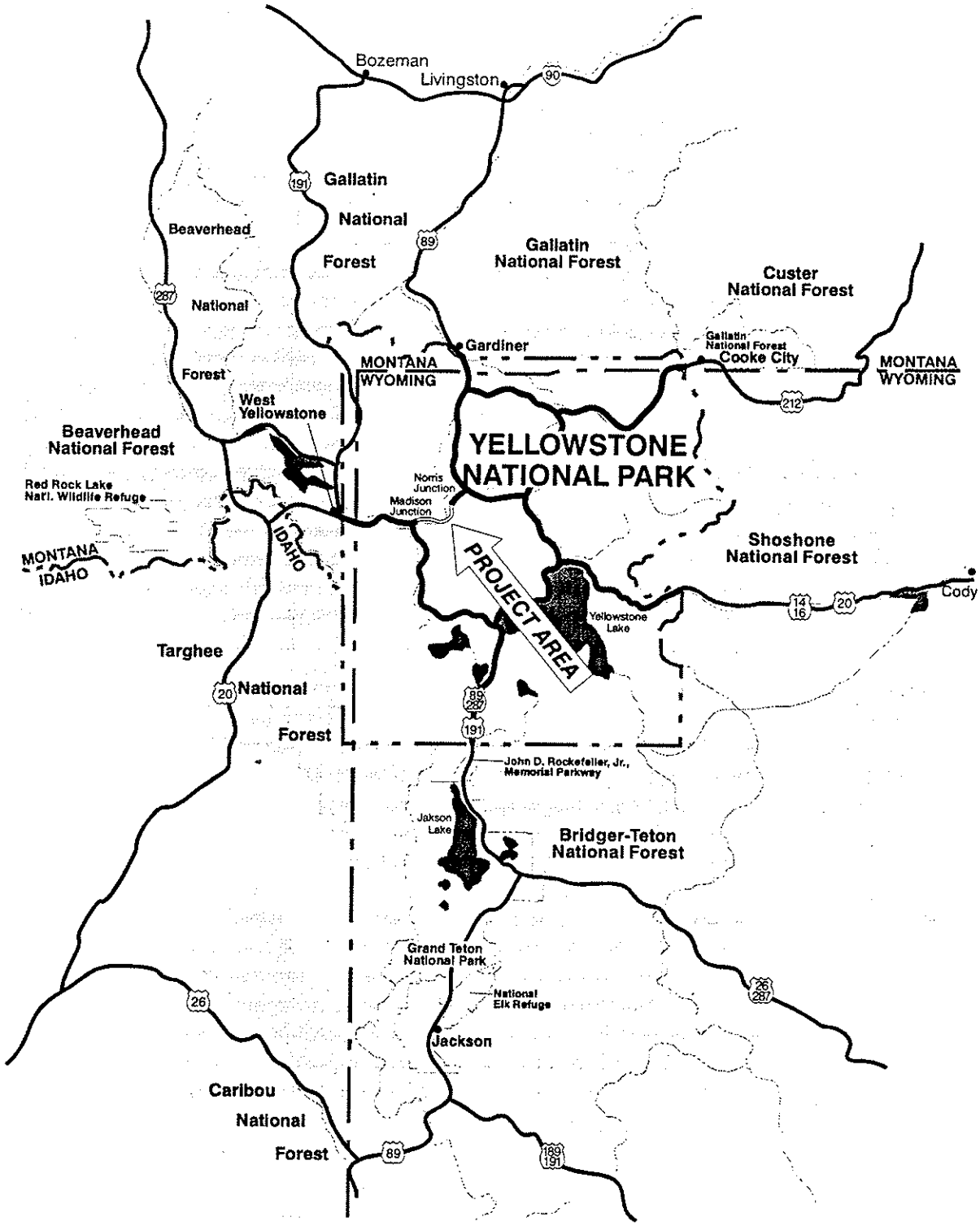
INTRODUCTION

Park roads, such as those in Yellowstone National Park, are intended to accommodate park visitors safely and efficiently while enhancing visitor experiences (NPS Park Road Standards 1984). The National Park Service is responsible for constructing, operating, and maintaining its roads in a safe and aesthetically pleasing condition to the greatest extent possible.

In keeping with this mandate, the National Park Service, in cooperation with the Federal Highway Administration, is in the process of rehabilitating or reconstructing the principal park roads in Yellowstone. The Surface Transportation Assistance Act (PL 97-424), passed in 1982, established the federal lands highways program (FLHP). This program distributes funds from federal motor fuel tax revenues for work on roads in parks and on other federally administered lands. Reconstruction of the park road between Old Faithful and West Thumb, recent paving overlay work between West Entrance and Madison and between Norris and Canyon, and reconstruction of the Grand Loop Road between Madison Junction and Biscuit Basin are examples of work performed under this program. Reconstruction of the road between the Fishing Bridge intersection and the East Entrance began in the summer of 1994 and will be completed in several construction phases over the next three to six years. Road improvements in Yellowstone generally take many years to complete because of limited funding, a relatively short construction season, and the park's desire to allow visitor traffic through construction zones.

The next major road reconstruction project for Yellowstone under FLHP is the improvement of the Grand Loop Roads from Madison Junction to Norris Junction on the west side of the park (see Vicinity map). Work is proposed to begin in mid-1999 and be completed in several construction phases over the following four to six years, subject to availability of funding. This *Environmental Assessment, Madison Junction/Norris Junction Road Improvement* describes the proposed project, the alternatives considered, and the associated environmental effects. The proposals in this document are based on standards and guidelines set forth in the *Parkwide Road Improvement Plan*, completed in June 1992. That plan described the road improvement program that is expected to be carried out in Yellowstone over the next 20 or more years. It established standards for improvement of the park's principal roads (for example, width and design speed) and analyzed the cumulative effects of the long-term road improvement program. This route-specific environmental assessment evaluates the effects of road improvement in the Madison Junction/Norris Junction project area, and it documents current compliance activities. It will be used in applying for project-specific permits and ensuring that appropriate mitigating measures are implemented.



VICINITY

Madison Junction to Norris Junction

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PURPOSE OF AND NEED FOR THE ACTION

The National Park Service (NPS) is proposing to improve a 16.3-kilometer (10-mile) segment of the Grand Loop Road between Madison Junction and Norris Junction. Construction would occur from the NPS service area access road, just north of Madison Junction, north to Gibbon Meadows picnic area. Improvement of the road is needed in order to establish a road that meets acceptable engineering safety standards, to provide safe and pleasant driving experiences, to facilitate park operations and emergency services, to improve resource protection, and to enable more efficient use of park funds. The Madison Junction/Norris Junction road segment was identified in the *Parkwide Road Improvement Plan* as the next priority for major reconstruction in the park after the Madison to Biscuit Basin segment, which began in 1995 and was completed in 1998.

The Madison Junction/Norris Junction road segment connects the West Entrance to the Norris Geyser Basin and the North Entrance of the park (see Vicinity map). The road also connects the northern part of the park to Old Faithful. It provides a road corridor between Yellowstone National Park and communities such as West Yellowstone and Gardiner, Montana. This road provides a critical link in the Grand Loop Road system and access to the Gibbon River, Gibbon Falls, Artist Paint Pots, and Beryl Spring areas. The road is predominately a through or connector road with visitor attractions along the way. There are two designated picnic areas, two trailheads, and no campgrounds located along this road.

This road segment was originally constructed by the U.S. Army Corps of Engineers and was completed in 1905. It was reconstructed during the mid-1930s, and additional work was completed from the mid-1950s to the mid-1960s as part of the NPS Mission `66 program. Much of the road is typical of the older roads in Yellowstone that have not had complete reconstruction for more than 50 years. The top width and base material were not designed to accommodate the greater traffic volumes and wider and heavier vehicles of today. As with other older park roads, maintenance costs are escalating at an accelerating rate just to keep the road passable.

The Madison Junction/Norris Junction road segment receives some of the heaviest use in the park. The volume of traffic in conjunction with the narrow and winding road alignment result in congested traffic flow with a high probability of long delays to road users. Visitors travel over this road between such features as Old Faithful, Norris Geyser Basin, Canyon, and Mammoth. In 1996 the park received in excess of 3 million recreational visits, and visitation over the past five years has ranged from 2.9 million to 3.14 million. These visits represented more than one million vehicles entering the park and using the road system within the six-month period from May through October. The West Entrance accounted for approximately 37 percent of the vehicles, and the North Entrance provided access for approximately 19 percent of the total. The Madison Junction/Norris Junction road segment had an annual average daily traffic (ADT) of 2,785 vehicles in 1993. More significantly, the peak season (summer) ADT was 5,333 vehicles. The NPS *Park Road Standards* recommend minimum widths of 3.4 meters (11 feet) per lane and 1.2 meters (4 feet) per shoulder for an ADT of 4,000 – 8,000. However, road design elements, such as width are influenced by numerous factors, including park resource considerations, existing and/or planned volumes and types of traffic, safety, terrain, and design speed.

Large vehicles (including buses, service and delivery trucks, and recreational vehicles) make up about 13.3% of the traffic volume. In the 1980s the Department of Transportation increased the maximum legal width of motor vehicles to 8 feet, 6 inches; side mirrors extend beyond this width. The number of large buses is expected to increase because of the upward trend in senior citizen and foreign tour group visits. Cross-country bicyclists use the park roads, and other visitors transport bicycles to the park for short local bike trips. Bicycle traffic volume is unrecorded but noticeably increasing.

The condition of the Madison Junction/Norris Junction road segment is generally poor. Lack of drainage, frost heaving, infiltration of water into the base and subbase, pavement deterioration from thermal ground areas, and poor road building materials all contribute to the continuing deterioration of the road. The roadway pavement width varies from 6.7 to 7.4 meters (22 to 24 feet), and much of the road has abrupt pavement edges and no shoulders. The asphalt pavement surface is rough and breaking up, with numerous potholes, cracks, and frost boils. Many of the complaint letters from park visitors concern the rough road surfaces. Drainage deficiencies contribute to rough and rutted pavement. Ditches and culverts are inadequate or clogged with sinter deposits and do not carry surface water away from the roadway. Improperly located or undersized drainage structures also limit natural streamflow under the roadway and often affect wetland functions. A high percentage of the road subgrade and base material is of poor quality, with an excessive proportion of fine material that draws moisture into the base structure; this contributes to excessive flexing and damage to the pavement surface, and in combination with the traffic, results in rutting and broken pavement.

A number of safety issues are related to the existing road design. Some pullouts and intersections have limited inadequate sight distance for drivers entering or exiting traffic lanes. Bicyclists are often in danger because the roadway is narrow. Some sections of the road do not comply with current engineering safety standards for curve configurations. Tanker Curve is rated as the worst accident location in the park, and Gibbon Falls is rated as the eighth worst accident location. The road is inconsistent with its adjoining segments (e.g. narrower, rougher driving surface, limited sight distances), which poses a safety hazard to unsuspecting motorists who are unfamiliar with the road and rugged terrain. Ditches are generally shallow and do not prevent falling rocks from hitting travel lanes or motorists. Numerous instances of material or debris slides have occurred in the Gibbon River canyon which in two instances resulted in visitor vehicles being pushed into the river. The existing bridge railings on the Gibbon River Bridges No. 1 and No. 2 do not meet current safety standards. These safety problems diminish the enjoyment of traveling the road, require a greater than normal amount of driver concentration, contribute to accidents, and require frequent maintenance.

In the project area, there is insufficient and inadequate pullouts or formal roadside parking for motorists to stop and safely enjoy the scenery. Visitors have created informal pullouts along the road that intrude on sensitive resource areas and are located in unsafe areas. Some of the formal parking areas were not designed to meet current needs; they do not properly direct motorists or maximize parking capacities, and they may pose safety hazards. During much of the summer season, these areas are congested and at maximum capacity.

High water events have impacted road stability. There are three areas of severe erosion along the road. One location is near the Tuff Cliffs, where headward erosion of an adjacent erosion gully threatens to undermine the road. Two erosion/debris flow areas within the Gibbon Canyon, north of Iron Spring, are the result of steep slopes and unstable soils, which are further exacerbated by the loss of vegetative cover during the 1988 fires. Debris flows have occurred intermittently since that time. The road corridor through these areas is about 6.7 meters (22 feet) wide with thermal features and rare plant species on one side of the road and the Gibbon River on the other. The park has been hauling the erosion debris that blocks the road and placing it in proper disposal areas, but in spite of these efforts, some debris does reach the river.

The *Parkwide Road Improvement Plan* proposed that most principal park roads be reconstructed on their existing alignments. In the Madison Junction/Norris Junction area, however, there is an opportunity to consider alternate alignments for some sections of the road. At Terrace Spring the road currently passes immediately adjacent to the thermal feature, with the flows routed along and through a culvert beneath the road. Thus, the road affects the natural flow of waters from the spring. As mentioned, the road corridor is very narrow through portions of the Gibbon Canyon, with environmental concerns for the adjacent Gibbon River, thermal features, wetlands, and rare plant species. The unstable slopes are subject to hazardous landslides/debris flows that pose safety and maintenance problems. The potential adverse affects to resources and motorist safety along the existing road alignment warrants investigation of alternative realignments for sections of road in the Gibbon Canyon.

The *Alternate Transportation Modes Feasibility Study, Yellowstone National Park* (BRW, Inc. 1994) looked at various modes of transportation for Yellowstone visitors and proposed a visitor transportation system based on buses. If such a system was implemented, improvement of the road segment between Madison Junction and Norris Junction would be required to accommodate the volume of bus traffic that the system would generate and to minimize any related impacts.

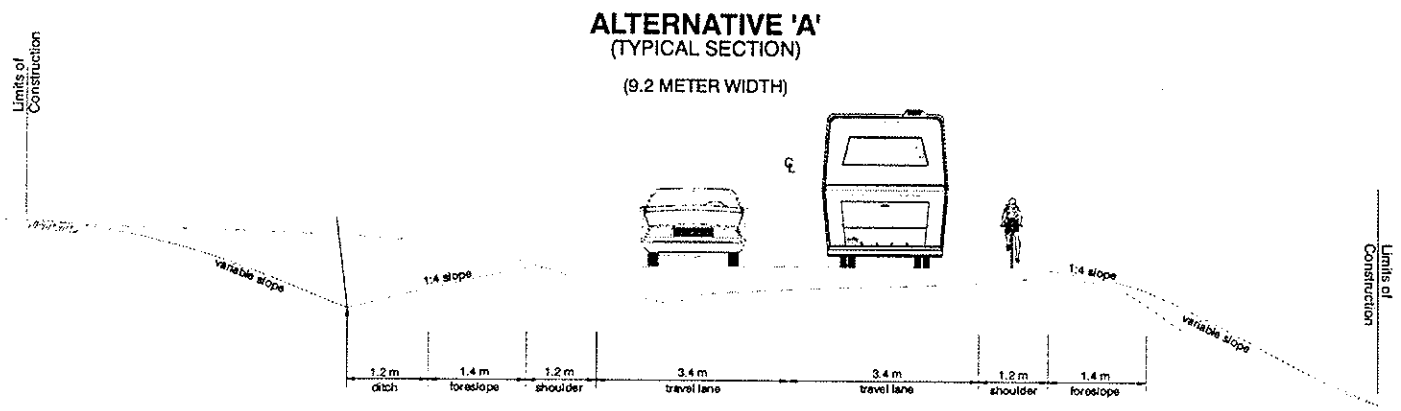
ALTERNATIVES CONSIDERED

Two width alternatives, 9.2 meters (30 feet) and 7.4 meters (24 feet), are presented in this section. A number of possible combinations of various realignment options at each of these widths was considered (see "Alternatives Considered But Rejected" section). The following alternatives were determined to be the most reasonable and feasible range of alternatives, considering both width and realignment options.

ALTERNATIVE A (PREFERRED): RECONSTRUCT EXISTING ROADWAY ALIGNMENT TO A 9.2-METER (30-FOOT) PAVEMENT WIDTH WITH GIBBON FALLS TO TANKER CURVE REALIGNMENT

The preferred alternative is to reconstruct 16.3 kilometers (10 miles) of the Grand Loop Road between Madison Junction and the Gibbon Meadows picnic area, located 5.1 kilometers (3.2 miles) south of Norris Junction, to a 9.2-meter (30-foot) paved width (3.4-meter/11-foot travel lanes and 1.2-meter/4-foot paved shoulders). The existing road alignment would be followed except between Gibbon Falls and Tanker Curve, where the road would be realigned out of the narrow Gibbon Canyon. The road segment through the canyon would be removed and the area restored.

This alternative is preferred because, in addition to improving the condition of the road pavement and its underlying structure, the wider width and new alignment would provide additional transportation advantages over the other alternatives. The wider road would handle higher traffic volumes, allow smoother traffic flow, provide more room for vehicles to pass bicycles and pedestrians, enhance the maneuverability of larger vehicles, and provide a consistent width with the recently improved segment of road from the Gibbon Meadows picnic area to Norris junction, which is 9.2 meters (30 feet) wide. Realignment of the road out of the narrow, winding Gibbon Canyon would also improve operating conditions. Currently, debris flows often block the road, posing safety hazards and requiring frequent costly maintenance. So, although total acreage impacted would be somewhat greater under this alternative, traffic flow, safety, and visitor experience would be much improved. Plus, reestablishment of a more natural landform and naturally functioning river system through the Gibbon Canyon would be accomplished.



Design Recommendations

Reconstruction Section. The posted speed limit for most of the road segment would be maintained at 35 miles-per-hour. Specific sites such as Terrace Springs, Gibbon Falls, and Beryl Springs may be posted at lower speeds due to traffic congestion in these areas.

The existing pavement would be recycled and therefore would be milled and stockpiled for use within the new pavement structure. Areas where roadway soils are of poor-quality would be repaired by excavating them and replacing them with better draining aggregates. New base material would be imported or obtained from cuts elsewhere in the project. The roadway would also be widened by excavation of cut slopes and or addition of embankment fill. Wherever possible, roadway widening would be confined to one side, with the centerline shifted accordingly to avoid important natural or cultural features and minimize cut and fill slopes along the roadside. Centerline shifts would depend on existing road geometry and would comply with safety design standards.

A fill slope ratio of 1:4 (rise:run) would be the design standard for the slope from the edge of the pavement to the bottom of the ditch or where the slope catches the natural terrain. These flatter slopes have the effect of: providing greater success for an errant vehicle to return to the road; eliminating the need for guardrails; and aiding reclamation/revegetation, but they extend the slopes horizontally and widen the construction area. Deviation from this design standard would occur in sensitive resources areas where walls or steeper slopes, perhaps with guardwalls or guardrails, could be used.

Most cuts and fills would be about 3 to 6 meter (10 to 20 foot) tall, with maximum cuts of about 26 meters (85 feet) tall and maximum fills of about 6 meters (20 feet) tall. The largest cut is at Gibbon Falls. A large existing cut slope would be further excavated to improve the stability of the slope. The existing cut is approximately 450 meters (1,500 feet) in length and up to 50 meters (165 feet) high. This cut would be extended an additional 50 meters (165 feet) in length and 3 meters (10 feet) in height. Rock cuts would be designed and treated to minimize visual impacts by producing a form and texture compatible with natural rock outcrops and cliffs. Drill holes from blasting would be removed. Excavation into stable cliffs would be made at steep angles to reduce disturbance. Some slope tops might need to be rounded back to reduce rockfall and ditches provided at the bottom to catch falling rock. Soil slopes would be flattened (slope angle reduced) where required to reduce erosion and promote revegetation.

About 1,400 meters (4,600 feet) of wall would be used in about 14 places to reduce disturbance in cut and fill situations. Four possible types of walls have been identified for use. The standard concrete wall with a simulated masonry pattern would be used the most. These simulated stone walls would have a similar visual effect as those recently constructed on the East Entrance Road. They range in height from 2.0 to 3.75 meters (6.5 to 12.2 feet) tall. At the highest cut a 6-meter (20-foot) high rock buttress, essentially a dry-laid (stacked rock) sloped wall, may be used. In intermediate height areas, a 3 to 4.5-meter (10 to 15-foot) high rockery wall or possibly a soil nail wall may be used. A rockery wall consists of large blocky stones stacked to create a steep retaining wall. A soil nail wall involves reinforcing soil material within the area being excavated by installing steel bars horizontally into the slope. Soil nail walls, if used, would be faced with natural or simulated stone similar to other walls on the road segment

Highway guardrails or guardwalls could be used in select areas. To ensure compatibility with the roadway historic district, new guardrails would be steel-back log or masonry guardwalls, similar to those installed on portions of the East Entrance road. All historic dry-laid stone retaining walls impacted by construction would be repaired and restored, except those walls along the segment of the road through the Gibbon River canyon that would be removed. Stone from obliterated retaining walls and culvert headwalls would be salvaged and used elsewhere on the project or stockpiled for use on a future project in the park.

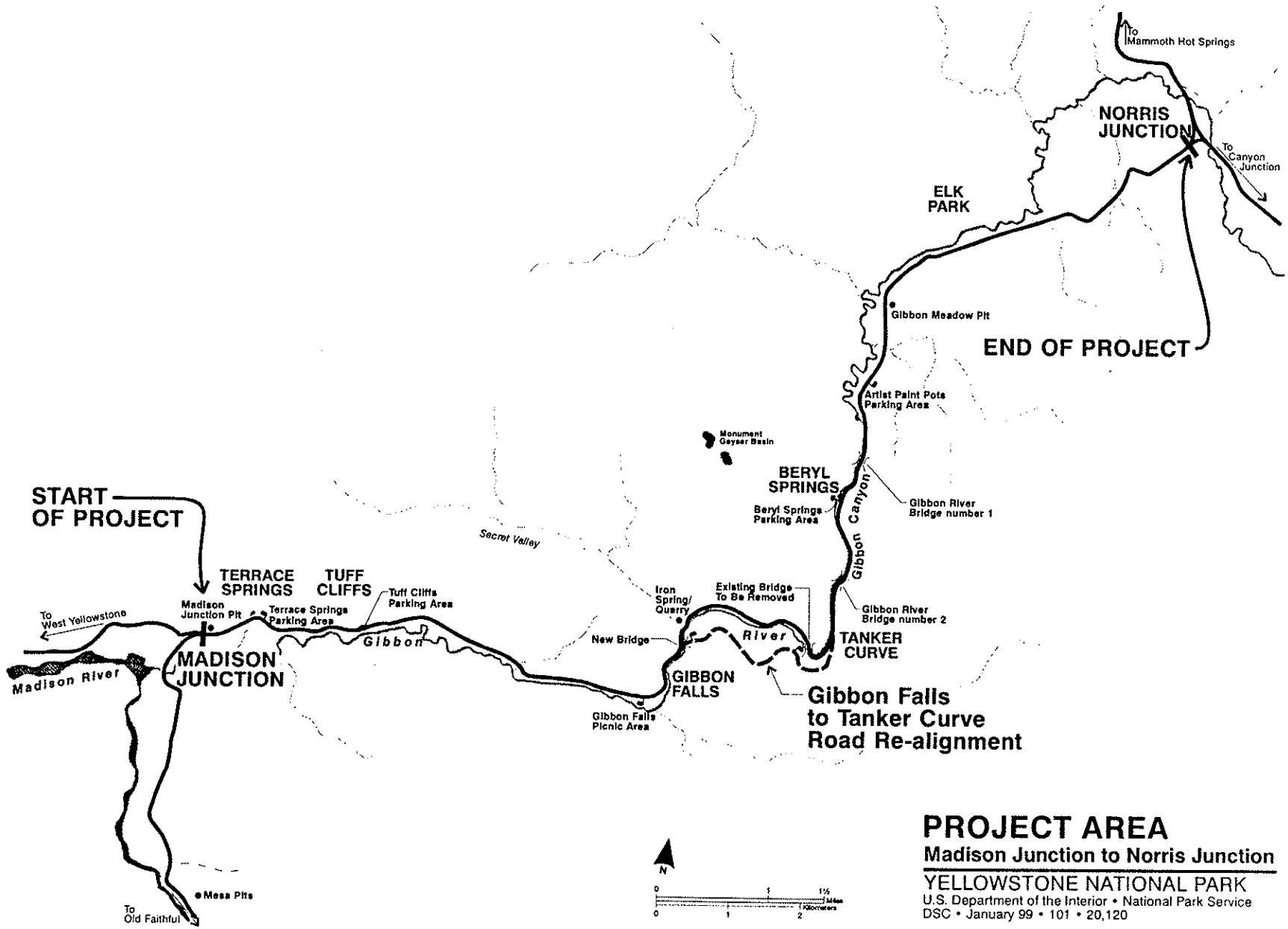
There are several places where the road is over or near thermal features or high thermal heat flow areas. A special pavement design would be constructed in the new road prism to help control heat dissipation and moisture penetration in these areas. This design would be used in all thermally sensitive areas throughout the project.

Where trees would be cleared within construction limits, this would be done so that an irregular forest edge remained. Minimal vista clearing would be carried out in selected areas to improve views from the highway.

Realignment Section. A 3.0-kilometer (1.9-mile) section of new road would be constructed between Gibbon Falls and Tanker Curve. Beginning just north of Gibbon Falls, a new bridge would be built to access the area across the river. The road would follow an upland route above the canyon and rejoin the existing alignment just north of Tanker Curve on the same side of the river. The 2.9-kilometer (1.8-mile) abandoned section of the existing road along with one modern concrete bridge in the Gibbon Canyon between Gibbon Falls and Tanker Curve would be removed, and the area would be returned to a more natural state. Erosion control measures would be implemented to enhance slope stability and revegetation and to minimize sedimentation. The slopes would be recontoured and revegetated to reestablish a more natural landform. This would likely require the removal of some trees. However, some roadside cut or fill slopes may not be completely restored to a pre-disturbance landform in order to save some existing trees or protect other resources. Roadway embankment protection (i.e. fill, riprap) along approximately 400 meters (1,300) feet of the riverbanks and bed that constricts the channel or changes the channel pattern would be removed to reestablish a more naturally functioning river system.

Repair Section. A 6.4-kilometer (4-mile) section of road, from Gibbon Meadows picnic area to Norris Junction, was recently resurfaced. The existing roadway 9.2-meter (30-foot) width and alignment would be maintained. In thermally influenced areas, the existing roadway would be excavated and a special pavement design would be used to help control heat dissipation and moisture penetration. Two to three pullouts would be added, and existing informal pullouts would be obliterated and revegetated along this section of road. Four segments of old road scars totaling approximately one kilometer (0.6 mile) in length by approximately 4 to 5 meters (13 to 17 feet) in width may also be obliterated and revegetated.

Bridges. There are four bridges in this section of the Grand Loop Road. The Beryl Springs bridge, a modern wooden structure that functions more like a viaduct, would not be widened because the bridge is of sufficient width to accommodate the new roadway. However, the existing wooden bridge rail would be replaced with a round log steel backed bridge rail. The two historic bridges, Gibbon River Bridge No. 1 and No. 2, would be modified to improve safety and accommodate the wider road width. These



PROJECT AREA

Madison Junction to Norris Junction

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two bridges are eligible for the National Register and are contributing features to the Grand Loop Road Historic District. They were constructed in the 1930s. The stone masonry piers would remain but the decks would be widened. The newly widened decks would match the existing deck in design and materials. The new deck would be treated to darken the concrete, thus matching the existing color. The technique used to widen these bridges would be the same as used on the historic Nez Perce Bridge. The existing abutments would need to be widened to accommodate the wider road. The stones on the abutments would be numbered, removed, and replaced on the widened concrete abutments, in the same pattern as they now appear. The existing bridge rails on the two Gibbon River bridges do not meet current safety standards and would be replaced with new square structural steel railing that would also be the same as used on the Nez Perce Bridge. The existing modern concrete bridge just south of Tanker Curve would be removed, as it would no longer be needed.

A new bridge would be constructed north of Gibbon Falls and would not be visible when viewing the falls from the Gibbon Falls Overlook. The proposed new bridge will be visually compatible with the surrounding area and rustic character of other bridge structures in the Grand Loop Road Historic District. Conceptual and final designs will be made available for compliance review at the appropriate time prior to the construction schedule for this phase.

Culverts and Headwalls. Culverts would be replaced, headwalls would be removed and reconstructed, and new culverts added where necessary to correct drainage problems. Pipe culverts would be replaced and lengthened to compensate for a wider roadway. Culvert design would allow fish passage. To maintain the historic character of the roadway, design and materials for new culvert headwalls would be consistent with stipulations agreed upon by the Advisory Council on Historic Preservation (ACHP), National Park Service, and Wyoming State Historic Preservation Officer (SHPO) in the 1994 (as amended) programmatic agreement.

Treatment of the historic stone culvert headwalls would also adhere to provisions of the programmatic agreement; that is, historic stone headwalls that retain physical integrity and are visible from the road or other visitor use areas would be documented, dismantled, and reconstructed after pipe replacement. Stone from headwalls that did not meet the criteria of historic integrity and visibility would be salvaged for reuse elsewhere. Representative culverts and headwalls have been documented using the Historic Building/Structure Survey Form and the List of Classified Structures Single Entry Report. The park has completed documentation of the historic roadway features. The Wyoming SHPO has reviewed this documentation, and on October 22, 1998, concurred that these features contribute to the National Register eligibility of the Grand Loop Road. This documentation completes the park's survey responsibilities.

Approximately 82 culverts with stone headwalls are visible from the roadway and would be affected by road widening. Many of these headwalls are in fair to poor condition and require stone replacement. New stones would be selected and cut to match the existing masonry.

Parking Areas and Pullouts. There would be an overall net increase in total parking, including additional parking for recreational vehicles. About 30 to 35 informal and formal pullouts would be retained and improved at key wildlife and scenic viewing areas, fishing access points, and other areas of interest. These standard parallel pullouts would

be approximately 5.0 meters (17 feet) wide with tapers. They would range in length to accommodate 3 to 18 vehicles, including parking for recreational vehicles. All of them would utilize alignment shifts, informal or gravel pullouts, existing paved pullouts, or otherwise previously disturbed areas. Some informal pullouts and parking areas would be obliterated and revegetated.

New and reconstructed parking areas and pullouts would be designed to be in scale with the natural and historic setting. Use of native materials would maintain the continuity and historic character of the roadway. Logs or stone would be used for curbing. Walls would be of native rock, rock veneer, or simulated stone stained to match native rock. Medians between the roadway and parking would be constructed of cobblestone. Round pealed log posts would be used for all signs. Parking areas and pullouts would have appropriate drainage structures and sediment control devices installed. As funding is available, additional vault toilets would be placed at trailheads and picnic areas. Restrooms and other structures would be of a rustic design to reduce their visual intrusion on the historic scene and ensure that they were compatible with the adjacent Grand Loop Road Historic District. These are the same design details that were used between Madison Junction and Biscuit Basin and on the Craig Pass road reconstruction.

Terrace Springs – The existing pullouts would be obliterated, and a new formal parking area and access road would be constructed just to the northeast. Relocating this parking area would improve safety by providing increased sight distance and eliminating roadside parking along the curve that is often obscured by steam from the nearby springs and thermal pool. The new parking area would connect to the existing trail system. On the opposite side of the road, a pullout would be constructed in a more appropriate location to replace an existing turnout located to the south. This southern turnout would be returned to natural conditions.

Tuff Cliff – The existing parking area would be redesigned and reconstructed primarily within the existing disturbed area. The existing vault toilet would be relocated.

Gibbon Falls Picnic Area – The access road would be relocated to improve safety. The existing picnic area plus an adjoining 2 hectares (5 acres) would be used for staging and material stockpile for construction activities. This area lies within the boundaries of a very large National Register-eligible archeological site with both historic and prehistoric components. The areas with the highest concentration of historic features and prehistoric concentrations would be avoided. No topsoil would be removed. An asphalt pugmill or a concrete batch plant may be located where data recovery has been completed. A Data Recovery Plan has been developed and approved by the Wyoming SHPO and the ACHP. The area that would be impacted by staging and storage has been defined, and data would be retrieved from significant archeological features prior to any disturbance. After construction activities are completed, a new Gibbon Falls Picnic Area would be created at the staging area.

Gibbon Falls Overlook – As a result of shifting the road alignment to the northwest and stabilizing the large cut across from the parking area, adequate space would be available for expansion of the parking and viewing area. Vehicles would be pulled back from the edge and moved to the north. The stone guardrails on top of the historic masonry retaining walls would be repaired with matching stone. Old asphalt may be milled away, helping to lower the asphalt build-up against the stone guardwall and masonry retaining walls. Proposed designs would separate vehicle and pedestrian traffic.

Paved parking area at this site would increase by approximately 1100 square meters (1315 square yards).

Beryl Springs – Parking would be redesigned to improve safety. A median would separate the road and parking area. The existing viewing area would also be redesigned to enhance viewing of the spring. The boardwalk and observation platform would be reconfigured further from the road.

Artist Paint Pots – The existing parking facility is too small, which causes pedestrians and traffic to spill out onto the Grand Loop Road causing unsafe conditions. It also was constructed on wetlands. Therefore this parking area would be expanded and relocated about 250 meters (820 feet) further east of the road where there are fewer impacts to wetlands. The access road would also be relocated and extended. The existing parking area would be restored to natural conditions. Areas to be occupied by the relocated parking lot and access road would be surveyed for cultural resources, resources evaluated, and, if needed, mitigating measures developed prior to construction. A portion of the Artist Paint Pot trail would be relocated to access the new parking area.

Gibbon Falls to Tanker Curve realignment – A small picnic area would be constructed at the north end of the new bridge. It would have a short access road, parking, picnic tables, and an observation deck for views of the canyon. Another small picnic area would be constructed at the north end of the realignment section near Tanker Curve. It would have an access road, parking, picnic tables, and an observation deck.

Material Source

Aggregate material for this project would be obtained from contractor located sources outside of the park boundaries or possibly from the Sylvan Pass pit in the park. About 160,000 metric tons of aggregate material would be used for the Madison Junction/Norris Junction road improvement. In addition, about 70,000 metric tons of select borrow would be required, although this quantity might decrease depending on the suitability of material obtained from rock cuts. Limited road base material would be obtained by recycling asphalt removed from the existing road. Before transporting into the park, out-of-park material would be certified as free of weed seed or the material would be treated to eliminate exotic plants and seeds. The material would be stored and transported so as to minimize introduction of exotic species. Equipment would be steam-cleaned and checked for cleanliness.

Select stone is needed for masonry work on structures such as bridges, headwalls, approach walls, curbs, and walkways to maintain their historic character. If suitable, boulders and rocks within the construction limits would be used as a source of stone or other material. The masonry culvert headwalls and retaining walls along the canyon would be salvaged and the stone reused where needed. The Norris rock quarry would be used as a material source site for masonry rock. Supplemental sources of rock outside of the park would also be used if necessary.

Staging, Stockpiling, and Disposal Sites

Six areas would be considered for staging and/or stockpiling for all phases of this project. At the west end of the project area, the Mesa Burn pits 2 and 3 could be used for staging and stockpiling. Archeological inventories, evaluation, and, if needed, mitigating measures and additional Section 106 compliance, would be completed prior to stockpiling at Mesa Burn Pit 3. Should Mesa Burn Pit 2 be used for stockpiling, additional Section 106 compliance and development of mitigating measures would also be developed prior to use to ensure that National Register-eligible site 48YE768 is protected. Within the project limits, the Madison Junction pit, Gibbon Falls picnic area, Iron Spring Quarry, part of the area cleared for the Gibbon Falls to Tanker Curve realignment, and the Gibbon Meadow pit could be used for staging and stockpiling. An asphalt pugmill or concrete batch plant may be set-up at one of these locations (except at Iron Spring Quarry), or at the site of the Norris hot mix plant. A cultural resource survey of Mesa pits 1 and 2, Iron Spring Quarry, Gibbon Falls picnic area, and the Madison Junction pit was completed and has been used to guide design of the staging areas to avoid or reduce impacts. No construction excavation or topsoil removal would occur at the Gibbon Falls picnic area. A consultation agreement resulted in Historical American Engineering Record (HAER) documentation of the National Register-eligible archeological site at the Iron Spring Quarry to mitigate the adverse effect of filling in the quarry. Documentation has been completed.

The above three pits and quarry as well as possibly the Ice Lake pit would be used as disposal sites for waste or excess material generated by the project. This would complete the Abandoned Mined Lands (AML) reclamation for this site. Some waste material may also be used for landscaping purposes at other sites such as Madison Campground. Excess materials could be used to create berms between the road and the Madison Junction Campground. These berms would avoid National Register eligible site 48YE365, and help reduce traffic noise and headlight glare from the adjacent road. Work limits and mitigation measures would be defined in construction contract specifications. High quality material would be taken to the Gibbon Meadow pit, Norris asphalt plant, or other sites for use in other construction projects. The net quantity of material for disposal would be about 190,000 cubic meters (250,000 cubic yards) because most of the total material generated would be recycled back into the road project in some manner - as select borrow, stone masonry, topsoil on completed slopes, or natural contour fill along the roadway. The Madison Junction pit and Iron Spring Quarry would be restored after the project was complete.

Some pullouts and parking areas within the project limits would be closed to the public to allow for storage of construction equipment or materials. Gibbon Falls picnic area would be closed to the public. Truck turn-around areas would be necessary throughout the project area. Existing disturbed areas, such as informal pullouts and parking areas, would be used where possible. The turn-arounds would be well marked and delineated to reduce inadvertent impacts.

Construction Stipulations and Mitigation

Measures to mitigate the adverse environmental and cultural resource impacts of this alternative have been incorporated into the road design. These measures are intended to avoid, minimize, or rectify impacts as described in 40 CFR 1508.20. Additional mitigating measures to protect sensitive wildlife and threatened and endangered species would be initiated as operating stipulations. These measures and stipulations are described below.

Reclamation/Revegetation. Reclamation and revegetation following established guidelines (see Appendix A, "Vegetation Management for Construction in Yellowstone National Park") would be funded and implemented as part of the road improvement project. The park policy is to conserve topsoil and salvage vegetation for reclamation of disturbed areas.

During construction, topsoil would be salvaged, stored in windrows, and reused during reclamation to reduce long-term soil loss. No imported topsoil would be used in reclamation, however if compost becomes available it could be used. Borrow and aggregate materials and construction equipment would be carefully checked to avoid the importation of exotic vegetation. (Requirements to eliminate or mitigate exotics from construction equipment and materials are discussed in Appendix A.) Native plant materials would be used for revegetation, and areas disturbed by construction would be monitored for early detection and removal of exotic species. Standard, approved erosion control techniques and structures would be used during and after completion of construction. Human disturbed areas contributing sediment to surface waters as a result of construction activities would be promptly stabilized and revegetated to maintain water quality.

At the Gibbon River canyon road realignment site the old roadbed would be obliterated, and the site would be recontoured and revegetated to reestablish a more natural landform. Approximately 1.9 hectares (4.8 acres) would be recontoured and revegetated. Excess earth materials from road reconstruction would be used in reestablishing natural contours along the old cut.

As stated earlier, two pits/quarries (Madison, Iron Spring) and possibly a third (Ice Lake pit) would be reclaimed after completion of the project. Implementation of sensitive landscape designs would minimize impacts on archeological resources during grading or other ground-disturbing activities associated with area reclamation at the staging sites.

Geology/Thermal Features. Before construction, existing geological benchmarks would be relocated away from the road by personnel of the Cascades Volcano Observatory of the U.S. Geological Survey (USGS).

Subsurface investigations and blasting during road construction could affect geothermal areas. Subsurface investigations would be carried out under the guidelines being developed by park staff. Blasting techniques would be defined in the contract specifications. In some areas, blasting would be prohibited.

Roadside geothermal features would be avoided where possible by shifting the centerline away from the feature. Where small geothermal areas could not be avoided, a special pavement design would be constructed in the new road prism to help control heat dissipation and moisture penetration. In instances where thermal features would be

affected by a full-width road prism, small retaining walls of native rock, or steepened side slopes with rock curb, would be placed to keep fill materials from covering or affecting the thermal features. These walls would be designed to be compatible with other historic features along the roadway.

At Terrace Springs the road would follow the existing alignment traversing the thermal feature. The roadway would be built up using the thermal pavement design, culvert pipes would be installed to facilitate natural drainage patterns, and guardwalls or log guardrail would be used to improve roadway safety. An existing culvert is located under the road adjacent to the thermal pool, with a constructed drainage ditch parallel to the downhill side of the road. This culvert would be relocated to the southwest of the thermal pool, and the downhill hot water outflow channel would be allowed to reestablish a more natural drainage pattern.

Wetlands. All wetlands within 60 meters (200 feet) of the road alignment were surveyed and mapped before road design began so the designer could reduce impacts to wetlands. Techniques to avoid or minimize wetland impacts included shifting the centerline to avoid wetlands and steepening fill slopes to avoid or reduce areas of fill at specific wetlands. Removal of existing road and embankment fill in the Gibbon River canyon would allow the restoration of a more naturally functioning river system and hydrological patterns. This would also promote the development of wetlands in deposition areas along the channel, much like those that exist in unimpacted reaches of the river.

Wetland mitigation for unavoidable impacts would be accomplished through restoration of a minimum of 0.96 hectare (2.4 acres) of previously disturbed wetlands in the project vicinity. The Federal Highway Administration would apply for a 404 permit from the Army Corps of Engineers and a 401 certificate from the Wyoming Department of Environmental Quality.

Wildlife. Construction employees would be given instruction on safety in areas frequented by bison to avoid potential bison/human conflicts.

Threatened and Endangered Species. Much of the project area is in important grizzly bear habitat. To mitigate the effect of human activity on bears along the road corridor during and following construction activities, the following actions would be incorporated as part of the proposal.

All project-related employees, such as contract and government construction employees, will be given orientation regarding food storage, disposal of garbage and other bear attractants, and approaching or harassing wildlife.

Material sources within the park would be limited to areas within the construction limits for the project.

At staging areas, no long-term food storage or garbage retention would be permitted. Only bear-proof garbage cans would be used in designated staging or construction-related sites and would be emptied regularly.

No employee or contractor camps would be permitted outside of existing park residential or camping areas, if housing is required for such employees within the park. Security guards would be assigned, as necessary, to staging areas to help patrol for food security.

If carrion or associated bear activity are documented in the project vicinity, site specific use restrictions may be imposed.

Project design would minimize road-kills of wildlife by maintaining the general curvature of the road and existing speed limits.

Because of the nature of wolves to travel widely, there is potential for wolf activity in the project area. The project stipulations outlined for grizzly bears would include an orientation on wolves.

A pair of bald eagles nest near Madison. The nest would be monitored during construction. An active Peregrine eyrie is also in the project area. Blasting during road construction would be prohibited from April 25 through June 15 to avoid disturbing peregrines during the incubation period.

Cultural Resources. Historic properties (including archeological sites and historic structures and features) that have been determined to be eligible for the National Register of Historic Places would be protected and preserved according to the 1994 (as amended) programmatic agreement ("Programmatic Agreement Among NPS, ACHP, Wyoming SHPO, Montana SHPO, for Principal Park Road System Improvement, Yellowstone National Park"). Protective measures and proposed mitigation are discussed below. On October 2, 1998, the Wyoming SHPO concurred with NPS recommendations for National Register eligibility of those structures that could be affected by road construction, completing the NPS responsibilities for structure survey and evaluation as outlined in the Programmatic Agreement.

A plan for treatment of prehistoric sites was developed by the Midwest Archeological Center in 1993 (NPS 1993a). An addendum to this treatment plan, addressing historic archeological sites, was developed by William Hunt in 1993 (NPS, 1993b). Both plans have been reviewed by the Wyoming SHPO and the ACHP. These plans provide general guidance for resource-sensitive treatment and protection strategies.

The proposed roadwork and staging areas have been designed, as much as possible, to avoid historic properties eligible for the National Register, including archeological sites. In addition, appropriate stop-work provisions and provisions for borrow sources and stockpile areas would be included in the project specifications to minimize potential impacts on historic and archeological resources.

Discovery procedures have been developed outlining the process to be followed in the event of an inadvertent discovery. Work limits would be defined in areas near historic properties to prevent inadvertent damage to sites. Sensitive design, monitoring of construction, fencing, and definition of work limits would prevent any adverse project impacts.

A Data Recovery Plan for National Register-eligible site 48YE867 at Gibbon Falls picnic area has been developed to mitigate the adverse effects of construction material storage and staging. This plan was approved by the Wyoming SHPO and ACHP in 1997, and data recovery occurred during the summer of 1998. No topsoil would be removed from this area. Agreement on measures to mitigate the adverse effect of reclamation of National Register-eligible site 48YE723 (the Iron Spring Quarry) has been arrived at between Yellowstone National Park and the Wyoming SHPO and ACHP. The required documentation of the site is complete.

The Madison Junction Campground has been surveyed for archeological and cultural resources, and site 48YE365 has been documented. The site would be avoided during placement of excess materials (berms) between the road and the campground. The location, size, and placement of the berms would be clearly defined to prevent inadvertent damage to any archeological resources.

If any other sites determined to be eligible for the National Register could not be avoided by construction, they would also be addressed in a data recovery plan, and appropriate mitigation would be included.

A 3.0 kilometer (1.9 mile) long portion of Grand Loop Road from Gibbon Falls to Tanker Curve would be obliterated. The Grand Loop Road Historic District has been determined eligible for the National Register. The Madison to Norris road segment is part of this district, and its bridges, culverts, and walls are contributing features. Yellowstone National Park determined that the Tanker Curve realignment is an adverse effect. The Wyoming SHPO concurred October 6, 1997. Consultation between the SHPO and the park will result in development of a Memorandum of Agreement (MOA) to mitigate this adverse effect. The Federal Highway Administration and ACHP will be provided the opportunity to review, comment, and sign off on the MOA developed by the Wyoming SHPO and Yellowstone National Park.

Through the use of natural materials and designs that are compatible with the Grand Loop Road Historic District, roads, parking areas, and pullouts could be modified without adverse effects on their historic qualities.

All contract, NPS, and FHWA employees working directly with the Madison to Norris road reconstruction would receive training in protocol related to cultural resources. This would include discovery procedures as well as the handling of artifacts or suspected artifacts. The contractor would be responsible for compliance with cultural resources protection laws and regulations.

Scheduling of Work Activities. This project is expected to be constructed in three phases; Madison Junction to Gibbon Falls picnic area (including grading of the realignment segment), Gibbon Falls picnic area to Tanker Curve (including completion of realignment segment and new bridge), and Tanker Curve to Gibbon Meadow. Construction is expected to begin in approximately 1999 and continue through about 2004 subject to funding.

Road closures would vary from year to year depending on specific construction work. In general, the road may be closed at night (approximately 9:00pm to 9:00am) from around mid-June to Labor Day. After Labor Day the road may be open only at specific times (such as 6:00am to 10:00am and 6:00pm to 10:00pm). After October 1, the road may be closed for the season. However, to accomplish work from the Gibbon Falls picnic area to the end of the Tanker Curve realignment segment, a road closure of longer duration would be likely, with total road closure from early August until the end of one construction season (approximately August 7 through November 1).

Visitor Information. Even with the road open, some visitors would encounter up to 30-minute traffic delays because of road construction activities. Park staff would develop and implement a public information program to alert people to closures and projected delays. With closures, reconstruction could be completed in a shorter time, greatly reducing the impacts of additional construction seasons.

Other Stipulations. No additional housing or offices would be built because of this project. Some contractor employee housing and offices could be provided within the park in existing park housing/administrative areas. A contractor camp to be used on multiple construction projects may be built, and would be separately analyzed.

During construction, standard erosion control precautions, as outlined under section 204 of *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects* and stipulated in the contract specifications, would be implemented. Sediment and other pollution would be controlled on site so that it did not enter nearby streams or creeks. During the construction of bridges, barriers and fences would be erected below abutments and drainages to minimize pollutants reaching river waters.

Any use of or association with hazardous materials would require contractor compliance with applicable federal, state, and local laws, codes, ordinances, and regulations. In addition, the *Yellowstone National Park Hazardous Materials Response Plan* (NPS 1993c) would be followed to mitigate potential hazardous material incidents within the park boundary and similar incidents outside the boundary requiring mutual aid.

The Federal Highway Administration would develop a pollution prevention plan with the Wyoming Department of Environmental Quality under the national pollution discharge and elimination system (NPDES) stormwater management program.

Equipment would not be serviced or refueled near streams; parking and staging areas would be at least 45 meters (150 feet) from streams or riparian areas. Fuel would be stored in fuel trucks or above-ground storage tanks, and all fuel storage would be in staging areas. Refueling would take place in staging areas and might occur at material source sites.

A mitigation program designed to minimize fugitive dust from construction activities would be implemented. No chemicals would be used in dust abatement. Dust abatement would include watering of disturbed areas.

Vehicle traffic would be managed within the construction zone, and contractor hauling of materials, supplies, and equipment would be controlled.

Visitor Transportation System

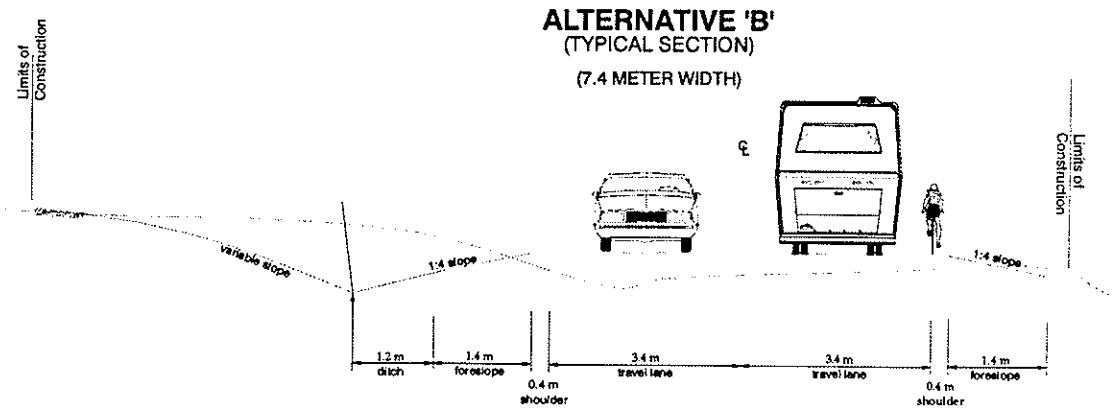
The Intermodal Surface Transportation Efficiency Act of 1991 called for a study of alternative means of transportation in national parks. Three parks, including Yellowstone, were selected for specific study. The *Alternate Transportation Modes Feasibility Study, Yellowstone National Park*, which looks at various modes of transportation for Yellowstone visitors, proposes a visitor transportation system based on buses. Key to such a system is an adequately designed, constructed, and maintained road network. At present a bus system would be adversely affected because of the poor condition of many of Yellowstone's roads. This alternative for the Madison Junction/Norris Junction road project would provide the necessary improvements to allow implementation of a bus system along this section of Grand Loop.

Project Cost

Implementing this alternative, including material excavation and processing, road construction, bridge modifications, and reclamation, would require $22 – 25 million (1998 dollars).

ALTERNATIVE B: RECONSTRUCT EXISTING ROADWAY ALIGNMENT TO A 7.4-METER (24-FOOT) PAVEMENT WIDTH

A 16.3-kilometer (10-mile) section of the Grand Loop Road between Madison Junction and the Gibbon Meadows picnic area would be reconstructed on the existing alignment to a 7.4-meter (24-foot) paved width (3.4-meter/11-foot travel lanes and 0.3-meter/1-foot paved shoulders).



Design Recommendations

Reconstruction Section. The design recommendations would be the same as in Alternative A, except the intent of this alternative is to reduce construction impacts from the 9.2-meter width alternative. Consequently, exceptions to design speed, fill slopes, and cut slopes could occur more often.

In the Gibbon Canyon the proposed road design would raise the road elevation to meet the 50 year flood event, however slope protection (riprap) would be required along the shoreline of the river to protect the road from erosion. About 200 meters (655 feet) of rock walls, entailing 1,200 cubic meters (1,570 cubic yards) of rock, would be constructed along of the shoreline. Also, about 10,125 cubic meters (13,250 cubic yards) of riprap would be placed along 1,350 meters (4,430 feet) of the river.

Most cuts and fills would be in the 3 to 6- meter (10 to 20- foot) height range, with maximum cuts of about 26 meters (85 feet) in height and maximum fills of about 6 meters (20 feet) in height. As under Alternative A the largest cut is at Gibbon Falls. A large existing cut slope would be further excavated to improve the stability of the slope. The existing cut is approximately 450 meters (1,500 feet) in length and up to 50 meters (165 feet) high. This cut would be extended an additional 50 meters (165 feet) in length.

About 1,400 meters (4,600 feet) of wall would be used in about 14 places to reduce disturbance in cut and fill situations. As in Alternative A, four possible types of walls have been identified for use. The standard concrete wall with simulated rock veneer would be used the most. These simulated stone walls would have a similar visual effect as those recently constructed on the East Entrance Road. They range in height from 2.0 to 3.75 meters (6.5 to 12.2 feet) tall. At the highest cut a 6-meter (20-foot) high rock buttress would be used. In intermediate height areas a 3 to 4.5-meter (10 to 15-foot) high rockery wall or possibly a soil nail wall with native or artificial stone facing would be used. Highway guardrails or guardwalls could be used in select areas. To ensure compatibility with the roadway historic district, new guardrails would be steel-back log or masonry guardwalls, similar to those installed on portions of the East Entrance road. All historic dry-laid stone retaining walls impacted by construction would be repaired and restored.

There are several places where the road is over or near thermal features or high thermal heat flow areas. A special pavement design would be constructed in the new road prism to help control heat dissipation and moisture penetration in these areas. This design would be used in all thermally sensitive areas throughout the project.

Where trees would be cleared within construction limits, this would be done so that an irregular forest edge remained. Minimal vista clearing would be carried out in selected areas to improve views from the highway.

Bridges. The 7.4-meter (24-foot) roadway width would fit on all bridges. Consequently, no modifications to the decks of the bridges would be necessary. The existing bridge railings on the Gibbon River Bridges No. 1 and No. 2 do not meet current safety standards and would be replaced with new railing the same as those on Nez Perce bridge.

Culverts and Headwalls. Treatment of culverts and headwalls would be the same as in Alternative A.

Parking Areas and Pullouts. The same parking areas and pullouts would be constructed in this alternative as in Alternative A except for the two new parking/picnic areas along the realignment segment in Alternative A that would not be constructed.

Material Source

Proposals for obtaining materials for road improvement would be the same as described in Alternative A. Under this alternative, approximately 130,000 metric tons (143,300 tons) of material would be used for road improvement as well as about 55,000 metric tons (60,625 tons) of select borrow.

Staging, Stockpiling, and Disposal Sites

Locations for staging, stockpiling, and disposal of materials would be the same as described in Alternative A. The net quantity of waste material would be about 170,000 cubic meters (220,000 cubic yards). The Madison Junction pit, Iron Spring Quarry, and possibly the Ice Lake pit would be restored after completion of the project. Some

excess materials could be placed in berms between the Madison Campground and the edge of the Madison-Norris Road.

Construction Stipulations and Mitigation

Construction stipulations and mitigation would be the same as under Alternative A, with the following exceptions. Alternative B would involve more wetland mitigation than Alternative A due to disturbance of wetlands within the Gibbon River canyon. Wetland mitigation for unavoidable impacts would be accomplished through restoration of a minimum of 1.1 hectares (2.8 acres) of previously disturbed wetlands in the project area. Structures would have to be constructed to mitigate thermal cone, and debris slide areas.

Also, visitors would be subject to longer delays because the narrower road would restrict simultaneous construction activities and visitor passage.

Visitor Transportation System

Alternative B would provide the necessary road improvements to allow implementation of a bus system that would connect Old Faithful and West Yellowstone to Mammoth Hot Springs and Canyon Village.

Project Cost

Implementing this alternative, including material excavation and processing, and road construction, would require $15 – 18 million (1998 dollars).

ALTERNATIVE C: NO ACTION

No major road reconstruction work would occur in the Madison Junction/Norris Junction area in the near future. Existing use and maintenance of the road and ancillary features would continue. The need for frequent costly maintenance activities such as pothole patching, periodic chip-and-seal coat applications, and removal of rockfall and slumping debris would increase; in some roadway sections, regular road maintenance would be inadequate because the road has deteriorated to the point where substantial improvement has become necessary. Road maintenance activities would require an increasing proportion of park funds because FLHP funds would not be available. No modifications to alignments, road widths, slopes, pulloffs, bridges, culverts, walls, guardrails, or signs would be made, and no material excavation/site reclamation would be carried out. Road improvement projects that require large quantities of aggregate material, such as asphalt pavement overlays, would be deferred indefinitely, potentially resulting in road closures.

Implementation of a visitor transportation system using buses would be adversely affected because of the poor road condition and the inadequacy of the road to handle high volumes of bus traffic.

ALTERNATIVES CONSIDERED BUT REJECTED

Road Improvement Alternatives

A variety of road realignment alternatives were considered early in the project to evaluate portions of the road that had important park resource concerns (wetlands, unstable slopes, and hydrothermal resources).

Tanker Curve to Gibbon Falls picnic area. A road alignment on the east side of Gibbon Falls would continue the Tanker Curve realignment described in Alternative A and reconnect with the existing road just downstream of the Gibbon Falls picnic area. Such a realignment would require a 7% grade for 1.6 kilometers (1 mile), large through-cuts, and cut slope stabilization of the existing Gibbon Falls road viewing area. Vehicular access to an overlook of Gibbon Falls was an important criteria. To achieve this, two roads (the new realignment and the current road overlooking Gibbon Falls) rather than one would be required.

Iron Spring. An option was considered to relocate a section of road up onto a natural bench that parallels the existing road for 0.7 kilometer (0.4 mile) on the north side of the river near Iron Spring. Because the bench could only accommodate relocation of a short road section, the road would return to the existing alignment in the canyon bottom through the existing slide areas. Impacting new areas along the relocation was not considered more advantageous than reconstructing the road along the existing alignment as under Alternative B.

Terrace Springs Downslope. Below Terrace Spring, a route for the road across the flat between the road and the river was evaluated. A tentative alignment was laid out that would cross numerous, dynamic runoff channels from Terrace Springs. In order for the road to not create a dam, many culverts would be necessary, and those culverts would be subject to deposition from the thermal runoff. The road would also be considerably closer to the Gibbon River, increasing potential impacts to wildlife, including a bald eagle nesting site. This alternative was rejected because of a loss of direct access to Terrace Springs and impacts associated with space requirements for the construction of a vehicle turnaround space and spur road.

Terrace Springs Upslope. To remove the road from the thermal area at Terrace Springs, an upslope option would place the road on the rhyolite bench above the wet meadow. From the Madison Junction area, the road would have to climb at a very steep grade and make a number of sharp, 40 kilometers-per-hour (25 mph) curves to gain the rhyolite bench. Also as the route passes above Terrace Spring, the effect of the road on the source of the spring was uncertain. This alternative was rejected because the "tie-in" connection with the existing road at Madison Junction would require a major redesign of the government administration and housing area due to the bisection of this area, that would be caused due to this realignment.

Tanker Curve Two – Bridge Option. An option to bypass the sharp bend at Tanker Curve was considered by using two bridges across the Gibbon River. The cost of the bridges, a sizable through-cut, and sizable wetland area impacts caused this alternative to be rejected.

East Side Gibbon Meadows. The alternative of realigning the road to the east side of Gibbon Meadows would place the road east of the powerline in the lodgepole forests along the east side of the meadow. The existing road prism could be removed from the center of the meadow. The powerline could be buried as part of the realignment. Although the northern end of the realignment could be accomplished, the southern end would pass near the Artists Paint Pots and climb a steep ravine to the west of Paintpot Hill. Inspection of topographic maps revealed that once the ridge was gained south of Artists Paint Pots, the realignment would stay on the ridge until Canyon Creek (Gibbon Falls Picnic area). Standing water was visible in openings within the lodgepole forests east of Gibbon Meadows, and the realignment would have to cross these wet areas also, causing continued wetland impacts. This alternative was rejected due to wetland and topographic obstacles, and thermal area impacts.

East Side of Gibbon River. A total re-route from the Mesa Pit area (south of Madison Junction) to just north of Tanker Curve was evaluated. "Madison Junction" would move south approximately 1.6 kilometer (1 mile) to the vicinity of the Mesa Pit Road. The road would generally follow a powerline from the Mesa Pit area heading east to a crossing of Canyon Creek (across the river from Gibbon Falls Picnic area) where a 90-meter (300-foot) descent and ascent would be necessary. At Canyon Creek, a side road to Gibbon Falls would probably be needed to provide vehicular access to this feature. The realigned road would rejoin the Grand Loop north of Tanker Curve. The existing road from the Madison administrative area to Gibbon Falls Picnic area and from Gibbon Falls to Tanker Curve would be obliterated. It was concluded that this realignment could be built, but a re-route would be almost exclusively in lodgepole forest with few views of the river or surrounding hills. The length of the re-route, steep grades, and lack of scenery prompted the rejection of this alternative. However, this alternative's consideration led to the in-depth evaluation of a Tanker Curve bypass (Alternative A) around the steepest and most unstable portion of the Gibbon River canyon.

Various Width Alternative

A 9.2-meter road narrowing to a 7.4-meter road through the Gibbon River canyon with no realignment in the canyon section was considered to have inherent safety problems associated with the varying width of the road surface. Resource impacts would be slightly less than those associated with a 9.2-meter road through the canyon, but not considerably less. This being the result of space requirements for fill-side walls that would need to be constructed 1.2 meters (4 feet) off the fog line of the road. The 1.2-meter (4-foot) shoulders of the 9.2-meter road would allow for this 1.2-meter (4-foot) offset of the walls.

Material Source Alternatives

A number of alternative material sources were considered. Several in-park sources identified in the *Parkwide Road Improvement Plan* were sampled and tested by the FHWA. All sources failed to meet one or more of the following criteria: material quality, based on current federal specifications; minimal geothermal effects; and area of potential disturbance less than area of reclamation.

Sources outside of the park, at distances of about 160 kilometers (100 miles) from the project site were considered impractical because of long haul distances, travel time, increased traffic congestion, road deterioration, potential for accidents, possible exhaustion of these material sources, and high transportation costs.

The environmental effects of extracting in-park material sources would generally be comparable to those of extracting outside the park because both in-park and out-of-park sources are in the greater Yellowstone area and have comparable natural and cultural resource components and attributes. Compliance and reclamation requirements would have been similar to those for actions occurring off park lands.

TABLE 1. SUMMARY OF POTENTIAL IMPACTS OF ALTERNATIVES

Impact Topic	Alternative A (Preferred)	Alternative B	Alternative C (No Action)
Soils/Vegetation	Approximately 28 hectares (70 acres) of disturbance to soil and predominantly lodgepole pine vegetation would occur, including the loss of 0.2 hectare (0.5 acre) of rare plant habitat.	Approximately 24 hectares (59 acres) of disturbance to soil and predominantly lodgepole pine vegetation would occur, including the loss of 0.3 hectare (0.7 acre) of rare plant habitat.	Impacts to roadside soils and vegetation from vehicles using informal pullouts and maintenance of debris flows would continue.
Thermally Influenced Areas	Seven thermally influenced areas encompassing about 0.1 hectare (0.3 acre) would be impacted.	Ten thermally influenced areas encompassing about 0.2 hectare (0.5 acre) would be impacted.	No new impacts. Maintenance of debris flows would continue to impact adjacent thermal features.
Wetlands/Other Waters of the U.S.	Approximately 0.96 hectares (2.4 acres) of wetlands would be impacted. Mitigation would include restoration of at least the same amount of wetlands. A more naturally functioning river system would be restored in the Gibbon River canyon. Mitigating measures would be used to minimize water pollution from construction work.	Approximately 1.1 hectares (2.8 acres) of wetlands would be impacted. Mitigation would include restoration of at least the same amount of wetlands. Mitigating measures would be used to minimize water pollution from construction work.	Existing areas of roadside erosion and maintenance of debris flows would continue to affect water quality and wetlands.
Fisheries/Aquatic Resources	Short-term degradation of water quality due to siltation and turbidity, possible temporary reduction of loss of fish populations due to the same. Some migration of stream channel due to rehabilitation effort in canyon. Erosion control measures and revegetation would be used to minimize impacts.	Same as Alternative A except that no migration of stream channel.	No new impacts would occur.
Wildlife	Some increase in vehicle speeds could occur; however, road-kills are expected to remain low. Realignment of the road out of the Gibbon River canyon would likely benefit bears and allow restoration of wildlife habitat within the canyon.	Some increase in vehicle speeds could occur; however, road-kills are expected to remain low.	Road-kills would continue to contribute to wildlife mortalities; however, road-kills are expected to remain low.
Threatened and Endangered Species	This alternative is not likely to adversely affect threatened and endangered species.	Same as Alternative A.	Same as Alternative A.
Air Quality	Localized effects on air quality would be temporary and limited to the duration of construction.	Same as Alternative A.	No new impacts would occur.

TABLE 1. SUMMARY OF POTENTIAL IMPACTS OF ALTERNATIVES			
Impact Topic	**Alternative A (Preferred)**	**Alternative B**	**Alternative C (No Action)**
Prehistoric and Historic Archeological Resources	Archeological site 48YE865 would be monitored to ensure construction would be confined to non-contributing portions of the site. Site 48YE866 is ineligible for the National Register. Protective measures and data retrieval at sites 48YE867 and 48YE723 help mitigate any adverse effects. Protective measures will continue to be used for site 48YE768 at the Mesa Burn Pit 2, and additional surveys and compliance would be completed for Mesa Burn Pit 3 should it be used. Site 48YE365 will be avoided.	Same as Alternative A	Sites would continue slow deterioration from erosion and use of informal pullouts.
Historic Roadway System/Cultural Landscapes	Work would be guided by protective and mitigation measures in the 1994 PA so the effect of most of the construction would not be adverse. A memorandum of agreement will mitigate the adverse effect of the Tanker Curve realignment.	Work would be guided by protective and mitigation measures in the 1994 PA so the effect would not be adverse.	Adverse effects on highway structures would continue to occur through deterioration and informal parking.
Social/Economic	In the short-term, some visitors would be inconvenienced by road construction activities including 30 minute delays, closures during late fall, and total road closure for part of one summer season. Most businesses within the park would not be expected to be negatively affected in a noticeable manner. Businesses and individuals located outside the park should not be affected at all. The regional economy would be enhanced by construction expenditures of approximately $22 to $25 million and other spending induced by this work on the park road system. Long-term benefits would result from improved safety, a smoother and wider surface, and more enjoyable experiences for motorists and bicyclists. A wider road would better accommodate bus tours. The tourism segment of the regional economy would be made more secure by improvements to the road system within Yellowstone National Park. Park operations would improve because of reduced road maintenance costs, better access for park vehicles, and a safer roadway. Short-term costs to visitors and others would be more than offset by short- and long-term benefits.	Impacts on the socioeconomic environment would be similar to those of Alternative A, except some safety problems, especially bicycle and motor vehicle conflicts from traveling in the same direction, would not be adequately addressed. Commercial bicycle use may be restricted. Bus tours would be better accommodated, although not to the degree as under Alternative A due to the narrower road. Also traffic flow would not be appreciably improved. Traffic congestion and the likelihood of traffic interruptions or delays would persist. Also, in Alternative B, the dollar direct benefits from construction related expenditures would be less than that for Alternative A.	Continuing the current situation in the project area would not improve visitor experiences and would expose visitors, staff, and their property to increasing risk of injury and damage. Although the cost of road improvements would be avoided in the short-term, those savings would be achieved at the threat of major damage to life and property and much greater operational expenditures in the long run. On-going maintenance and safety problems would not be resolved. Commercial bicycle tours would not be allowed on this road segment.

AFFECTED ENVIRONMENT

REGIONAL CONTEXT

Yellowstone National Park encompasses about 2.2 million acres, primarily in northwestern Wyoming and extending into Idaho and Montana. The park has a surfaced road system of about 330 miles; roads enter from the north, northeast, east, south, and west and connect to the historic Grand Loop Road, a figure-eight road system (see the Vicinity map). The park road system was originally surfaced and paved before the beginning of World War II. Most roads have since deteriorated to the point where routine maintenance can no longer preserve them or provide visitors with safe and enjoyable driving experiences.

Yellowstone National Park is at the heart of the region known as the greater Yellowstone area. The area comprises almost 12 million acres and is one of the last largely intact ecosystems in the world's temperate zone. In addition to Yellowstone, the area contains two other national park system units — John D. Rockefeller, Jr., Memorial Parkway and Grand Teton National Park. Portions of seven national forests — Gallatin, Custer, Shoshone, Bridger-Teton, Targhee, Beaverhead-Deerlodge, and Caribou — are within the greater Yellowstone area, as are two units of the national wildlife refuge system, National Elk Refuge and Red Rocks National Wildlife Refuge. Although public lands make up the majority of the area, state and private lands are also included. The area extends across portions of 17 counties in 3 states. Yellowstone's size and the number of geopolitical entities at the federal, state, and local level combine to create a complex administrative environment within the greater Yellowstone area.

NATURAL RESOURCES

Geology, Topography, and Soils

The project area borders the northwestern portion of the Yellowstone caldera, a depression formed by a huge volcanic explosion about 600,000 years ago. More recent geological events included glaciation, which deposited glacial boulders, gravel, and tills over portions of this area.

Exclusive of local siliceous sinter, landslide, colluvium, and volcanic ash-rich stream deposits, there are only two main rock types present in the project area. One is the Lava Creek welded ashflow tuff which was emplaced by the caldera eruption. It forms the north and west walls of Gibbon Canyon. The Lava Creek welded ashflow tuff is of special concern because it is susceptible to sheet wash and debris flow movement if its slope is disturbed. The tuff weathers into a coarse granular sand, poor in nutrients and water retention capability. The second rock type includes the Plateau Rhyolite flows that make up the south and east canyon margins. The Nez Perce flow extends from the confluence of the Firehole River to the east beyond Canyon Creek. The Gibbon River flow extends from Tanker Curve to Norris junction, having originated behind the Gibbon Hill lava dome.

The project area is part of the Central Plateau, which has rugged, rolling plateau terrain. Elevation ranges from about 2,100 meters (6,800 feet) at Madison Junction to 2,300 meters (7,500 feet) near Norris Junction. From Madison to Norris the road follows the Gibbon River, traversing rolling and gently sloping terraces and alluvial fans between Madison Junction and where the road enters the Gibbon Canyon near Gibbon Falls. Steep, stream-cut ravines and gullies border the roadway on the south before entering the canyon. One of the gullies has severely eroded up to the road and threatens to undermine the roadway. The Gibbon Canyon consists of narrow alluvial flats along the river bottom bordered by steep slopes covered by coarse textured colluvium. Landslide or debris flow hazards are high in this area. North of the canyon, the terrain changes to more open, alluvial flats and old lake beds in the area of Gibbon Meadows and further north, Elk Park.

Geologic benchmarks have been placed along Grand Loop Road. These benchmarks are used for monitoring by the Cascades Volcano Observatory of the U.S. Geological Survey to determine ground deformation. They will be protected and, if necessary, relocated by Cascades Volcano Observatory before any construction activities.

Soils are predominately glacial till or colluvium in origin. The coarse, sandy soils have a poor water retaining capacity. Plant nutrient levels are low relative to the andesitic soils in the surrounding mountains. Debris flows are common along the steep slopes through the Gibbon Canyon, particularly north of Iron Spring. Hydrothermal soils occur near Terrace Spring and the north end of the project near the Norris Geyser Basin. Soils formed in diatomaceous lake deposits occur in Gibbon Meadows and Elk Park. Wetlands and shrublands are generally present where fine-grained alluvium occurs. This fine-grained soil consists of silt plus clay.

Hydrothermal Resources

Gibbon Canyon is affected by active major volcanic and tectonic processes. From Madison Junction to Gibbon Falls picnic area at the confluence of Canyon Creek, the most spectacular and exposed portion of the 630,000 year old Yellowstone Caldera rim rises up to 480 meters (1,455 feet) above the river and 120 to 350 meters (365 to 1,060 feet) above the buried crater floor to the south. North of the Gibbon Falls picnic area, the river canyon is oriented north-south by the active regional Gallatin to Teton Mountain ranges fault zone. Between Secret Valley and Tanker Curve, the canyon is oriented east-west by a major ring fracture fault zone movement.

There are numerous hydrothermal features located along the road corridor. They are created from movement of hot fluids and gases up along the caldera rim faults, regional faults, and ring fracture zones that usually emerge at or near the bottom of the canyon. There are also hundreds of near continuous warm and hot water springs or seeps that issue from the bank and stream bed of Gibbon River from just west of Tuff Cliff to about 150 meters (455 feet) west of Gibbon Falls picnic area. They often reach the surface under the road and on the north river bank from the confluence of Secret Creek to Tanker Curve; and on the east base of the canyon wall from Tanker Curve up to Artist Paint Pots. At Beryl Spring near the intersection of another ring fracture fault, high temperature springs, and fumaroles extend all the way across the canyon.

Vegetation

The dominant vegetation of the Madison-Norris road corridor is typical of Yellowstone National Park, being comprised of lodgepole pine forest, much of which was burned in 1988. The burned areas are now dominated by young lodgepole pines, with typical forest understory species such as elk sedge, Ross sedge, pine grass and fireweed appearing between the saplings. An extensive stretch of the road lies in the Gibbon Canyon adjacent to the Gibbon River. Numerous springs emerge in the canyon including thermal springs with the temperature above boiling, to cold water springs with little or no thermal component. The complex mosaic of temperature and chemistry in these springs is reflected by the unusual assemblages of plant species and communities. Also along the route are thermal barrens such as in the vicinity of Terrace Springs. The Gibbon Meadows at the north end of the project is an extensive wetland dominated by sedges and rushes which is also somewhat influenced by the thermal waters that flow into the meadows.

There are no federally listed or candidate (category 1) plant species that occur in the park. However, there are two endemic plant species that occur only in Yellowstone Park, *Agrostis rossiae* (Ross' bentgrass), which occurs in geothermal areas along the Firehole, and *Abronia ammophila* (Yellowstone sand verbena), which is restricted to sandy lakeshores. Since possible habitat for *Agrostis rossiae* occurs along the road segment, the thermal areas adjacent to the road were surveyed extensively for this species. Neither species was found along this segment of road.

The unusual variety of seeps and springs with varying temperatures and chemistry often intermingling in adjacent wetlands, and the variation in the chemistry of the several thermal areas near the road corridor, provided habitat for several vascular plant species of special concern. Plant species of special concern are those species that have been recognized by the state heritage programs as being rarely encountered within the state. Since Yellowstone occurs near the state boundaries of three states, Wyoming, Montana and Idaho, all three state lists were consulted though the primary emphasis was on surveying for Wyoming plant species of special concern. A total of 23 species of special concern occur along the road segment (NPS 1996a): *Aster frondosus, Carex buxbaumii, Carex cusickii, Carex flava, Carex leptalea, Carex livida, Carex parryana var. parryana, Cryptantha spiculifera, Dichanthelium acuminatum, Drosera anglica, Eleocharis flavescens var. thermalis, Eleocharis tenuis var.borealis, Epilobium palustre, Eriogonum flavum var. piperi, Eriophorum viridicarinatum, Gnaphalium microcephalum var. thermale, Heterotheca depressa, Juncus filiformis, Juncus tweedyi, Lonicera caerulea var. caurina, Muhlenbergia glomerata, Scirpus americanus and Selaginella selaginiodes.* Also, the only known occurrence in the park of the hybrid *Xstiporysopsis bloomeri* is in the vicinity of Terrace Spring. The survey resulted in the mapping of the boundaries of 115 sites within the road corridor where one or more of these species occur.

Wildlife

Elk, bison, mule deer, and moose make use of the Gibbon River valley; however, use by deer and moose is less evident than that by the resident herds of elk and bison. Small numbers of deer have been observed wintering, to the south and west of the project

limits, in the Upper Geyser Basin, and moose are seen occasionally and generally alone in the riparian zones along the Madison and Firehole rivers.

The interspersed bottomlands, wetlands or swales, and slopes along the Gibbon River provide bison and elk habitat. The thermal influence along the Gibbon River, particularly closer to Norris Geyser Basin, provides some amelioration of severe winter conditions for these wintering ungulates, who graze in the meadows and under the relatively sparse forest cover. The river also separates the road from higher elevation mountain elk winter range, providing a natural barrier between traffic and wildlife use.

Bison eat mostly grasses and sedges, such as are found in Elk Park and Gibbon Meadows and along the riparian corridor of the Gibbon River. Calves are born in the wintering areas, generally between about April 15 and May 31 of each year, and are often seen in the Madison Junction area. As opposed to using traditional "calving grounds," bison seek relatively high ground with some forest cover to give birth. Although historically bison calving has not concentrated in the Elk Park or Gibbon Meadows areas, these areas have the potential and the right habitat conditions to support significant bison calving (Meagher 1993).

Some 800 –1,400 elk reside in the Madison and Firehole valleys (Mack et al. 1990). This herd is essentially nonmigratory and "its overwinter survival depends heavily on thermal areas that reduce snow accumulations" (Ables and Ables 1987). Elk cows also give birth, slightly later each spring on average than bison, in various places not associated with habitual calving grounds. They too seek cover from predators, such as coyotes and grizzly bears. During an elk study on the Madison and Firehole valleys, elk nursery areas were observed in Madison Canyon and other areas primarily along the Firehole River outside of this road segment (NPS 1994a). Some elk also calve in nearly all directions from Madison Junction, along meadows and edge areas of both the Madison and Gibbon Rivers, and in an area located on the Mesa service road (accessed from the Madison Junction/Norris Junction road), and in the meadow near Norris Junction. After calving, the next most sensitive time of year for elk is during the rut (September and October); at this time bulls seek open meadows and areas of good visibility when procuring and defending harems.

Both bison and elk succumb to winter-kill; most deaths occur in the winter but they may take place well into the spring. Although winter-kill does not occur at a consistent rate from year to year, it provides a significant food source for scavengers, including coyotes, bald eagles, wolverines, and black and grizzly bears, in late winter and spring. After their emergence from winter dens, grizzly bears in Yellowstone use carrion and weakened ungulates, including calves, as a primary food source (Knight et al. 1984), and the reproductive success of female grizzlies is at least partly dependent on the availability of carrion on spring ranges (Mealey 1975; Picton 1978).

Ungulate concentration areas are protein-rich habitats that support or are close to concentrations of animal protein that can be used by grizzly bears and other predators or scavengers for food. Thermal areas of the Norris Geyser Basin and Sylvan Springs (west of Gibbon Meadow), and the corridor along the Gibbon River west of Madison junction to Tanker Curve have high ungulate use and habitat value as winter range.

Black bears are dispersed throughout the park. Although there is some habitat overlap with grizzly bears, black bears are more likely to be found in forested cover types than

grizzly bears, which dominate the meadows. Black bears mainly eat grasses, sedges, and herbaceous plants, but they will opportunistically feed on fish, insects, roots, pine nuts, and berries, and they will scavenge. Historically, black bears have been involved in more bear/human conflicts than grizzlies. Since the park's concerted efforts to remove artificial foods began in the early 1970s, black bears have been seen less frequently along roadsides and in developed areas, and conflicts between black bears and humans have declined. Grizzly bears are discussed in the "Threatened and Endangered Species" section below.

Red fox are rarely reported, but may be present, especially in the meadows such as Elk Park, Gibbon Meadows, and those near Madison and Norris Junctions. Although bobcats are rarely seen in the park, the habitat in the Gibbon Canyon likely supports these animals; one historic sighting report was near the north end of the Mesa service road. Mountain lions are infrequently reported in Gibbon Meadows or Gibbon Canyon. This area is generally summer range for lions. Snow depths in much of the park interior prevents much resident lion activity south of the northern range. Smaller mammals such as weasels, pine marten, and red squirrels are common in the forests of central Yellowstone. Wolverines, which are very wide-ranging and rarely seen scavengers, have been reported more than once in the Elk Park-Gibbon Meadows areas. This is likely due to the presence of ungulates and the potential for winterkill, which are highly associated with these thermally-influenced habitats. Riparian species such as river otter, muskrats, and mink are found along the Gibbon River. Beaver are not generally associated with this river corridor, although they are found in the Madison River system. All use the river or nearby banks for denning and escape (NPS 1994b).

The Madison Junction to Norris Junction road segment has one of the lowest rates of road-killed wildlife in the park. From 1989 to 1993, 10 large mammals (2% of the large mammals killed by vehicles within the park) were killed on this road segment. Most road-kills occurred along two sections of the road, Elk Park to Norris Junction and Madison Junction to Tuff Cliffs (NPS 1994c).

Data were primarily collected on bird species along the road segment in 1994 (NPS 1994d) Some bird species that are considered rare or sensitive may occur in the project vicinity. The black-backed woodpecker is primarily found in conifers, particularly spruce-fir forests or mixed lodgepole pine/spruce-fir forests. This bird is rarely observed along the Madison to Norris road segment because the habitat is almost exclusively lodgepole pine. The three-toed woodpecker is more frequently found along this road stretch than the black-backed woodpecker. The habitat required by this species primarily includes coniferous forests, especially disturbed sites with dead or dying trees. The boreal owl, although not documented along this section of road, is found throughout the park. The common loon prefers to nest on mountain lakes, in particular on Yellowstone Lake. They have not been recorded along this road. The great gray owl is found throughout the park, primarily in the subalpine zone in the summer and the montane and subalpine zones in the winter. Although habitat for this species exists along the road corridor, it has not been documented along the road. Harlequin ducks are typically found in fast-moving waters lined with boulders or cobbles. They have be found on occasion in the Gibbon River canyon, primarily during the month of May. The northern goshawk is rarely observed along this road segment. When observations do occur they are more of an incidental nature and are usually in concert with spring and fall migrations. The trumpeter swan is found in areas of the Gibbon River,

primarily from mid-October through February. There is no evidence of swans nesting along this section of road.

To assist in the understanding of amphibians, a survey of the Madison to Norris segment of the Grand Loop Road was conducted (Peterson et al. 1995). Based on historical records and the 1994 survey results, four species of amphibians: blotched tiger salamander, western (boreal) chorus frog, spotted frog, and western (boreal) toad and three species of reptiles (northern) sagebrush lizard, rubber boa, and western terrestrial (wandering) garter snake are known to occur in the project area.

Fisheries and Aquatic Resources

Fish, both native and introduced, are an important component of the park's animal life. When explorers first visited Yellowstone, the vast majority of lakes, and most streams above major waterfalls or cascades, were devoid of fish. As a result of stocking for increased angling opportunities in early park years, the Yellowstone fishery is now comprised of 13 native and five introduced species, including the native westslope and Yellowstone cutthroat trout, longnose dace, arctic grayling, longnose sucker, and the introduced brown, brook, and rainbow trout. This mixture provides high-quality angling opportunities for visitors as well as food for birds, otters, grizzly bears, and other wildlife.

The proposed reconstruction and improvement section of grand loop road between Madison Junction and Norris Junction runs adjacent to the Gibbon River, one of two major tributaries forming the Madison River. With the exception of its northern end near Norris Junction, the distance between the road and the river does not exceed 0.5 km. From its headwaters at Grebe Lake and Ice Lake, the Gibbon River flows south west through a combination of large meadows and forested streamside cover segments, many of which were burned in 1988. It contains three natural barriers which further separate the river into distinct reaches: the Gibbon Rapids, the Virginia Cascades (18.3 m) and the Little Gibbon Falls (7.6 m).

In its headwater reaches, the Gibbon River is a cold subalpine stream formed by natural precipitation. However, the river changes rapidly as it gathers thermal runoff, becoming warm enough to become highly productive year-around while receiving inputs of iron, sulphur and other chemical compounds contributed by the addition of the thermal water. The river receives a substantial amount of flow from adjacent hot springs and geysers, which typically increases alkalinity and ultimately bottom fauna productivity (Armitage 1958). This geothermal effect creates optimal trout habitat where fish and invertebrates are buffered against extremely low temperatures and ice formations, while experiencing a longer growing season (Varley and Schullery, 1983).

Fishery surveys completed throughout the century have identified eight different fish species in the Gibbon River. Native species include mountain whitefish Prosopium williamsoni and mottled sculpin Cottus bairdi (Jones et al. 1991). Numerous angler reports of Arctic grayling Thymallus Arcticus catches indicate the presence of this native species, although it is not known if a reproducing population exists. Westslope cutthroat trout Onchorhynchus clarki lewisi, which historically occurred below Gibbon Falls, have since been extirpated following stocking activities in the late 1800's and early 1900's. These activities resulted in the establishment of three non-native species of trout; brook

trout Salvelinus fontinalis, brown trout Salmo trutta, and rainbow trout Onchorhynchus mykiss (Varley 1981). These last three species have become well established throughout the drainage, and are currently managed as recreational fisheries.

Recreational fisheries value of the Gibbon River defined as the amount of annual angler effort is substantial as compared to other Yellowstone Park waters. In 1997, approximately 5% of the total angler effort in hours spent fishing in the park occurred on the Gibbon River, with slightly less than 4,200 anglers fishing for the year. It ranked 6th as the most popular body of water fished out of approximately 73 streams and lakes fished in the park. An estimated 81 percent of anglers were satisfied with their fishing experience in 1997, and nearly 65 percent were satisfied with the numbers of fish captured.

Benthic productivity of the Gibbon River and aquatic insect ecology has been studied in several environments (Taylor, et al. 1994, Vincent 1967). Because the river is affected by geothermal outputs, the aquatic environments are highly diverse and change quickly as water temperature and chemistry vary, becoming more complex toward the downstream reaches. Throughout the upper reaches, the Gibbon contains a diverse invertebrate fauna, represented by five different orders of insects (Vincent 1967). Thermal and chemical effluents entering the river are more favorable to certain taxa downstream, with an increase in the total number of organisms present.

Threatened and Endangered Species

Five species protected under provisions of the Endangered Species Act of 1973 (as amended) are present in Yellowstone National Park. The grizzly bear (Ursus arctos horribilis) and bald eagle (*Haliaeetus leucocephalus*) are classified as threatened. The peregrine falcon (*Falco peregrinus*) and whooping crane (*Grus americana*) are listed as endangered. The fifth species, the gray wolf (*Canis lupus*), was reintroduced into Yellowstone in 1995 and 1996 and is classified as a nonessential experimental population. Although additional flexibility for management of such a population is allowed under the final rule and special regulations promulgated in 1994 (59FR 60252), wolves that are part of the experimental population are considered a threatened species on any National Park Service or National Wildlife Refuge System lands.

Grizzly Bear. Fewer than 1,000 grizzlies are thought to survive in six areas of Montana, Wyoming, Idaho, and Washington. In 1983 the Interagency Grizzly Bear Committee (IGBC) was formed to ensure that the six ecosystems identified as grizzly bear recovery areas were managed in ways that would help grizzly bear recovery. The "Grizzly Bear Recovery Plan" (USFWS 1993) guides the recovery effort.

The greater Yellowstone grizzly bear population is the second largest of the recovery populations and is estimated to have a minimum of 280-610 bears (Eberhardt and Knight 1996). Grizzlies range over 2.2 million hectares (5.5 million acres) within the greater Yellowstone ecosystem, with nearly 40 percent of this range (0.9 million hectares or 2.2 million acres) within Yellowstone National Park. Yellowstone's bear management program is directed toward preserving and maintaining the grizzly bear population as part of the park's native fauna, while providing for visitor safety; recovery and management of the grizzly bear is of the highest priority

Grizzly bears display annual and seasonal variation in food habits. Bears forage on roots, bulbs, and the foliage of many forest, meadow, and marsh plants, and they prey on pocket gophers and invertebrates (ants) in open meadows and mature forests. Whitebark pine seeds have been shown to be a high-quality food source for grizzly bears, especially during late summer and fall (Mattson and Jonkel 1990). During early spring, following emergence from their dens, bears depend upon carrion as an available high protein food source. Ungulates wintering in the park tend to concentrate on the northern range or in thermal areas, such as those along the Madison and Gibbon Rivers, where vegetation is easier to obtain, and bears are known to travel to these areas upon den emergence.

To monitor bear population trends and to meaningfully analyze the effects of use or development on locally affected bears, occupied grizzly bear habitat in the Yellowstone ecosystem has been divided into 18 grizzly bear management units (BMUs). These habitat units were delineated based on the principle that each unit should contain a complete spring, summer, and fall habitat for grizzly bears. For most of the BMUs there is evidence that the habitat contains adequate food sources to support grizzly bears in all three seasons. The project area is in the Firehole/Hayden BMU. This unit has supported at least one female grizzly bear with cubs-of-the-year in four of the five years between 1990 and 1994. Additionally, with an average of 1.8 females with cubs per year, the unit is the fifth highest (of eighteen) in mean annual number of reproductively successful adult females per year. The high natality of the Firehole/Hayden BMU makes it critical to the reproductive success of the grizzly bear.

Mattson et al. (1987) describe a measurable zone of influence in which bear behavior becomes altered or diminished due to human presence. This zone of influence is a quantifiable value representative of the decreased habitat effectiveness in the immediate area of concentrated human use. Strictly evaluating habitat value (not accounting for human influences on habitat), a lower level of occupancy was found in areas near roads than was statistically expected (Mattson et al. 1987). This low effectiveness is a result of the reduced efficiency of foraging strategies and diminished travel opportunities in the presence of humans. Roads influence bear diurnal foraging activity within a zone of approximately 500 meters during the spring and summer seasons, and approximately 3000 meters during fall (Mattson et al. 1987).

From 1990 through 1994, a total of 65 bear sightings were reported within the spring, summer, and fall zones of influence of the Madison to Norris Road corridor. Twenty-nine (45%) of these sightings were reported as black bears, 28 (43%) as grizzly bears, and 8 (12%) as unknown species of bear. Of the 28 reported grizzly bears, 5 (18%) were females with cubs. The park is divided into 13 subdistricts for administrative and ranger patrol purposes. Overall, the Madison and Norris subdistricts in which the road corridor is located had a very low level of bear activity compared to other subdistricts in the park (ranking 11th and 13th respectively). The bear activity data showed a very low level of bear use of the road corridor in spring, with existing use mostly concentrated in the Gibbon Canyon. Due to sampling design, the bear activity data probably underestimated the amount of bear activity associated with winter-killed ungulate carcasses during the early spring. Ungulate carcasses are located mostly in the thermally influenced areas along the road corridor. The amount of bear activity along the road corridor increases slightly during the summer and fall. Summer use by bears was distributed along the entire road segment. In the fall, bear activity was concentrated around

Norris Junction, Gibbon Meadows, Terrace Springs, and Secret Valley Creek (NPS 1995).

There was one bear-human conflict reported along the road corridor during the period 1990 through 1994. An adult grizzly caused a traffic jam in the Elk Park area. During the 10 year period 1985 through 1994, there was one female grizzly bear hit and killed by a vehicle in the Gibbon Meadows area (NPS 1995).

Bald Eagle. Resident and migratory bald eagles use the park. Nesting sites occur primarily along the margins of Yellowstone, Shoshone, Heart, and Lewis lakes and along the shoreline of several of the larger rivers in the park. Park personnel believe eagle populations to be generally stable and possibly nearing maximum density.

Bald eagles prey on waterfowl and fish during the nesting season and waterfowl and carrion during the winter months. Bald eagles are observed year-round along the Madison and Gibbon Rivers. Bald eagle nesting does occur in the vicinity of Madison Junction.

Peregrine Falcon. Peregrine falcons are summer residents in Yellowstone from April through October, nesting on large cliffs that overlook rivers or valleys where prey is abundant. Peregrine populations are increasing. Open meadows, especially in riparian zones, and lakeshore habitats are used as foraging areas by the falcons; peregrines have been documented foraging in the open meadows of the Madison drainage and along the Gibbon River. One known eyrie exists on this road project.

Whooping Crane. Whooping cranes are occasional summer residents of Yellowstone. At present the whooping crane population in the park is down to one individual. In recent years this crane has summered in the southern half of the park. This crane is the last of the initial experiments, to cross-foster whooping crane eggs under sandhill crane nests, at Gray's Lake in Idaho. The population is expected to disappear in the future. Failure to pair bond and reproduce coupled with collisions with wires were prime reasons for the unsuccessful experiment.

Gray Wolf. Wolves in Yellowstone area are designated as an experimental population, and therefore no areas are designated as critical habitat for wolves (USFWS 1994). Human-caused mortality and availability of prey are the two most limiting factors for wolf populations (Mech 1970). To date most human-caused mortality in the Greater Yellowstone Area has come from management removals (mostly related to livestock depredations), illegal kills (from poaching), and by collisions with vehicles. Within Yellowstone National Park, there has been no mortality of wolves due to either management removals or illegal kills. Five wolves within the park have been killed in collisions with vehicles. Prey species for wolves are considered abundant in the park, with elk being the primary prey species.

As of January 1999, 120 wolves comprised of 10 groups or packs inhabit the Greater Yellowstone Area. At this time 35 wolves have been radio collared. 25 to 30 wolves are scheduled to be radio collared in early 1999. Wolves travel widely and do not appear to be disturbed by human presence, except during denning. Wolf pups are generally born in late March to May. During winter months, wolves frequent the Madison-Firehole drainage areas (south of the Gibbon River road segment) because of the abundance of elk. Sightings have occurred in the vicinity of the Gibbon River road segment.

Candidate or Proposed Species

Two native fish species which are present or occurred historically in the Gibbon River have been petitioned for listing under the Endangered Species Act (50 CFR Part 17). It has been determined that fluvial Arctic Grayling meet the criteria to be a candidate species to add to the list of threatened and endangered wildlife and plants. A current status review exists for westslope cutthroat trout (WSC). National Park Service's management goals mandate protection and restoration of native species, which includes present and future WSC re-introduction into the Gibbon River drainage by Yellowstone Park fishery staff.

Arctic Grayling. Arctic Grayling were originally distributed throughout the Gallatin Drainage, and in tributaries of the Madison drainage below Gibbon and Firehole Falls (Jordan 1889). Current distribution is limited to the historically fishless headwaters of the Gibbon River which now contain a few adfluvial (lake dwelling) populations in Grebe Lake and Ice Lake. A reproducing population of fluvial grayling (i.e. those which are permanently stream dwelling) may no longer occur in the park, although angler reports continue to indicate catches of grayling in the Madison and Gibbon Rivers.

Restoration efforts have occurred with Arctic grayling throughout the Gibbon River drainage. Grayling restoration work began initially in Grebe Lake at the grayling station operated from 1934 to 1951, following the introduction of grayling to Grebe Lake in 1921 (Varley 1981). Following the introduction, grayling were spread and stocked into Ice, Cascade, and Wolf Lakes, as well as into the upper Gibbon River. The Gibbon River was stocked with 5,343,004 grayling from this source (1933-1943, inclusive), with some grayling stocked there each year (Varley 1981).

Grayling from lacustrine sources were stocked in Canyon Creek, a tributary of the Gibbon River where grayling were historically native, in 1976, 1977, 1978 and 1980. Grayling of fluvial origin (Big Hole River) were also stocked there in 1976. The creek had been chemically treated to remove non-native trout and a barrier was built to prevent their recolonization from the Gibbon River. However, surveys revealed many non-native trout but few grayling in 1978 and no grayling in fall 1980 (Jones, et al. 1980, Kaya 1992). Although these attempts were unsuccessful, future efforts are pending based on management priorities.

Westslope Cutthroat Trout. Historical evidence indicates that westslope cutthroat trout were likewise distributed throughout the Gallatin River and Madison River drainages (Jordan 1889). The presence of non-native fish, namely rainbow trout, and transplanted Yellowstone cutthroat trout has reduced the distribution of this species and resulted in interbreeding and isolation of populations of unknown genetic structure.

Yellowstone Park fishery staff is currently identifying genetically pure populations of westlope cutthroat trout remaining within park boundaries by performing genetic surveys in small tributary streams in the northwest portion of the park. Tissue samples removed from the fins of collected fish are currently being sent for DNA analysis, which can identify genetically pure or hybrid individuals.

Potential candidate streams for restoring westslope cutthroat trout populations in Yellowstone National Park include Canyon Creek, a tributary of the Gibbon River which enters approximately 1 km below Gibbon Falls. Considerable work in preparing this

stream for re-introduction has been completed, including locating and removing non-native trout, and improving an existing log barrier to prevent re-invasion of non-native fish. Future restoration efforts include the Gibbon River mainstem along with additional tributaries as park managers continue its effort to re-establish native fish species such as westslope cutthroat trout.

Wetlands and Other Waters of the U.S.

The predominant water resource within the project area is the Gibbon River. It parallels the road for more than half the length of the road project. In the Gibbon Canyon (middle segment of the project) the road and river are in close proximity, with little space for expansion of the road or movement of the river. Such variables as changing river width and proximity of riverbanks and cliffs cause floodwaters to reach varying elevations as it moves down the canyon, flooding some portions of the existing road. Small tributaries that flow into the Gibbon in the project area are Canyon Creek, Secret Valley Creek, Geyser Creek, Tantalus Creek, and other unnamed creeks.

Streams and lakes in Yellowstone are designated as class I by the state of Wyoming, primarily for the purposes of wastewater discharge. Water quality in the project area is excellent, with near-pristine headwater conditions. Some natural turbidity and increase in color occurs in streams during high runoff in June and early July.

A wetland survey of the road corridor was completed in 1994 (NPS 1996b). A total of 93 wetland sites were found along this stretch of road. Wetlands were classified according to the wetland classification system of Cowardin et. al. (1979). Although this wetland classification system does not recognize thermally-influenced wetlands, wetland sites that were obviously thermally-influenced were further designated as such during the survey.

Wetlands were found within 200 feet of the roadway in approximately 70% of the stretch of road between Madison Junction and the north end of Gibbon Meadow. More than half of the wetlands found were seeps dominated by sedges, spikerushes, and grasses. About one-third of the sites were seasonally flooded wetlands along the banks of the Gibbon River. Forested wetlands dominated by lodgepole pine were found in 14 sites, while fire-killed lodgepole pine snags were found in six sites which were previously forested.

At least 29 of the wetland sites were determined to be thermally influenced. These sites were primarily concentrated in the vicinity of Beryl Spring, Terrace Spring, between Secret Valley and Tanker Curve, Monument Geyser Basin Trailhead, and the southern end of Gibbon Meadow. Plants found in these thermal wetlands included yellow spikerush, Tweedy's rush, rough bentgrass, beaked spikerush, Nebraska sedge, aster, and common monkey-flower.

The creation of the existing roadway has affected seeps and springs in at least 30 wetland sites. The roadway is elevated on fill across 4 major wetlands including 0.9 mile through Gibbon Meadow. The water flow is sufficiently close to the road that wetlands have developed in the roadside ditch in 20 sites. The elevated roadway has impounded the water in one wetland, while seeps appear in roadcuts in two other wetland sites. An artificial channel was created at Terrace Spring to facilitate drainage of the hot water

away from the roadway. Also, several old borrow pits were observed in and around Gibbon Meadow that support emergent wetlands.

Air Quality

Air quality and visibility are generally excellent. Yellowstone is a mandatory class 1 area where air quality degradation is unacceptable under the Clean Air Act of 1977. Acid precipitation is monitored at Tower, and ozone, sulfur oxides, and fine particulates are monitored at Lake.

CULTURAL RESOURCES

Prehistory Background

The earliest human use documented for the Yellowstone National Park area dates to 13,000 years before present when small groups of Paleoindians are thought to have roamed through the area, hunting big game animals. By about 7,500 years ago, major environmental changes greatly altered the range and quantity of plant and animal species. Archaic groups adapted to these changing conditions by developing new lithic technologies and by hunting small game and increasing their use of gathered wild plants. Yellowstone has material remains of cultures whose core areas were the Great Plains, the Great Basin, and the Intermountain Plateau. Traces of campsites, quarries, and food processing areas document the intensive prehistoric occupation of the area from around 7200 B.C. to A.D. 1600.

History Background

A number of tribes are known to have used this area historically, including the Crow, the Northern Arapahoe (Fort Washakie), Eastern Shoshone (Fort Washakie), Confederated Salish and Kootenai Tribes, Blackfeet, Nez Perce, Shoshone and Bannock Tribes at Fort Hall, and the Northern Cheyenne. Early Euroamerican explorers documented occupation of areas within the park by Shoshonean speaking bands known as "Sheepeaters" during the early and middle nineteenth century (Haines 1977:1:201). With ratification of treaties in 1882, the remaining Indians were moved out of the park to the Wind River, Shoshone, and Lemhi reservations.

During the latter part of the nineteenth century, Euroamericans homesteaded in the Yellowstone area. Increasing numbers of explorers, scientists, and visitors publicized Yellowstone's resources and scenery, leading to formal establishment of the area as Yellowstone National Park in 1872 under the Department of the Interior. Conflicts with the Nez Perce and Bannock Indians, combined with inadequate funding and personnel needed to control poaching and vandalism, resulted in transfer of park management to the United States Army in 1886. Early park management, the Army, and after 1916 the National Park Service, helped to shape the philosophical direction for the park. This philosophy carried over into design and construction of visitor facilities, including roads, stage stops, resorts, hotels, camps, and dumps. Included in this construction were numerous structures built in a style that has come to be known as rustic architecture.

Examples include Old Faithful Inn, the Norris, Madison, and Fishing Bridge Museums, and the Northeast Entrance Station, all National Historic Landmarks.

Development of the Yellowstone road system was a crucial element in park management and the growth of area tourism. The Grand Loop Road was the first large scale designed, planned system giving people access into the "scenic splendors" of the park. This effort by the Army Corps of Engineers created a national road in an isolated region at a time when American road building was in its infancy. The massive scope of the project, the extraordinary engineering problems posed by the climate and area geology, and the difficulty of transport and logistics made this a landmark effort. Additionally the techniques pioneered for building roads in a wilderness setting established precedents for later construction all over the nation.

The Yellowstone road system was initiated in 1877 when Superintendent Norris proposed a route or bridle path running along the Gibbon River from the north entrance at Mammoth Hot Springs to the west entrance to provide access to all the major points of interest. As use of the park increased, this section of road became the most heavily traveled in the park. Because of its bad condition, improvements were made in 1879 and 1880, and bridges were built to span the Gibbon River which had to be crossed three times in as many miles. The Army Corps of Engineers began road work in 1883, straightening and widening the roadway, reducing slopes, removing stumps, adding pullouts, and repairing bridges.

Known as the Kingman Road after Army Corps of Engineers 1st Lt. Dan Kingman, this route was the first permanent road in the park. Construction was incredibly difficult as engineers worked with excessive snow depths, heavy timber, canyons, mountainous terrain, and poor subsurface drainage caused by heavy clay soils and geyser activity.

In 1888 a road was built to connect the Norris Hotel with the road into Gibbon Canyon, and within two years, construction was begun on rock retaining walls in the Gibbon Canyon area. Between 1900 and 1904, the road through the Gibbon River canyon was raised, grades were lowered, and new bridges built. Repairs on the Gibbon Canyon retaining walls were begun in 1907. Between 1909 and 1929 the road was regraded and graveled, with most of the construction by National Park Service day labor. During the mid-1930s the road between Mammoth Hot Springs and the Cascades of the Firehole was realigned and rebuilt, generally paralleling or overlaying the earlier Norris Road. Bridges were replaced, and guardrails added. The 6.32 mile long Norris Junction bypass (a Mission 66 program) was completed by October, 1966, and the old road bed was abandoned.

Documentation of Cultural Resources

Early archeological research in the park generally was limited in scope and confined to non-systematic inventory. More recent site-specific surveys have been conducted along the Madison to Norris road segment, most in association with development projects at Madison Junction and Norris. Beginning in 1994 the National Park Service intensively inventoried the Madison to Norris Road section of the Grand Loop Road, and the proposed Gibbon Falls to Tanker Curve realignment route. The surveys extended 100 meters on each side of the existing road. Surveys included areas that could potentially be affected by road construction or be used as staging areas or material storage/pro-

cessing areas (Parks 1995). The road corridor from Norris Junction to the north edge of Gibbon Meadows was inventoried in 1995. Numerous surveys of the Norris Junction area, including the area of the possible reroute at Tanker Curve (Sanders 1996) have been conducted over the years (Taylor et al. 1964; Cannon 1995).

During the summer of 1995, six archeological sites along the road corridor were tested to aid in determining site boundaries, integrity, and National Register significance. The surveys and testing were conducted according to *The Secretary of the Interior Standards for Archeology and Historic Preservation* (NPS 1983a). The reports on the 1994 and 1995 surveys and testing also summarize the results of the previous work in the area (Parks 1995; Parks and Stupka-Burda 1996). The Yellowstone road system and associated historic bridges, walls, culverts, and landscape elements were also researched, inventoried, and evaluated as a historic district (Culpin 1994; Lingo 1996). Additional documentation is underway by Yellowstone National Park.

An ethnographic overview and assessment is underway by Loendorf and Nabokov (draft in review by NPS and affiliated tribes). This study will help identify traditional cultural properties that may be located in the project area. At the beginning of this project, the park initiated consultation with affiliated tribes through a scoping letter, and no ethnographic sites were identified within the project area.

Description and Significance of Cultural Resources

Several archeological sites were found within the area of potential effect (APE) along the roadway between Madison and Norris, and one site lies within an area proposed for use in stockpiling materials. Most of the sites are multi-component, containing both historic and prehistoric remains. Components of the latter will be discussed under the appropriate section below. Table 2 itemizes these sites and lists their National Register of Historic Places status. A number of other sites are situated in the vicinity of the road but are outside of the area of potential effect, so will not be discussed here.

Prehistoric Archeological Sites. The park's prehistoric archeological sites provide evidence of human occupation in this area as early as 11,000 B.C. These tangible remains provide the only viable means of understanding past cultures who lacked written records, and provide the basis for continued scientific research.

Site 48YE365 is a large prehistoric site containing subsurface deposits. The site is eligible for the National Register.

The prehistoric component of site 48YE867 is eligible for the National Register and was documented as an extensive and diffuse lithic scatter including materials dating to the Late Archaic and Late Prehistoric periods. This site contains buried cultural material. Chemical fingerprinting of selected obsidian specimens documents at least four distinct sources, and the large volume of materials suggests an extended period of occupation or repeated occupations.

The prehistoric component of site 48YE865, which is also eligible for the National Register, consists of scattered lithic flakes, raw materials, and tools. The volume of prehistoric materials indicates extensive or repeated use of the area.

Site 48YE866 (also a lithic scatter) appears to have few, if any subsurface deposits and a very limited range of lithic materials. This site is not eligible for the National Register.

Historic Archeological Sites. Yellowstone's historic resources reflect a number of significant historical themes, including the growth of tourism, Yellowstone as a "proving ground" for America's national park system, and the park's pioneer road transportation system. Archeological sites along the Madison to Norris road, dating from the late 1800s into the mid-20th century include dumps, remains of road-construction camps, and a quarry site. Several diffuse artifact scatters containing ceramic and glass sherds, metal cans, and other household debris are within the project area.

The National Register-eligible historic component of the multi-component site 48YE867 contains extensive evidence of twentieth century occupation relating to road construction.

Site 48YE723, the Iron Spring Quarry, consists of the remains of structural features, work stations, equipment, and other features within the quarry/gravel pit. It is likely that stone from this quarry was being used in 1903 to build the retaining walls for the road in the Gibbon Falls area. The quarry operated through the 1910's and perhaps until the early 1920's (Cannon and Phillips 1993:216). This site is eligible for the National Register with the historic trash component and the historic roadbed segments not contributing to eligibility.

The historic trash scatter component of National Register eligible site 48YE865 does not contribute to the sites eligibility.

48YE866 has a historic dump component which is ineligible for inclusion on the National Register.

48YE770 a National Register eligible dump in Mesa Pit 1 and 48YE789 a National Register eligible historic site of a CCC dump in Mesa Pit 3 will be inventoried prior to any use.

Site 48YE789 is eligible for the National Register. This historic site contains the remains of a Civilian Conservation Corps dump containing a dense concentration of household and road-related artifacts.

The Historic Road System. The Grand Loop Road Historic District has been determined eligible for the National Register of Historic Places. The Madison to Norris road segment is part of this district, and its bridges, culverts, and stone walls are important contributing features.

The early wagon and auto roads were used to bring visitors and supplies into the interior of the park. More recent construction has obliterated many of these early roads; others run parallel to the existing highway. Within the project area nine historic road segments have been documented. These road segments are ineligible for the National Register (Wyoming SHPO 03/19/97) due to the lack of distinctive engineering and composition features.

There are a number of highway structures, including bridges, culverts, masonry walls, and retaining walls that contribute to the National Register significance of the Grand Loop Road. The Gibbon River bridges numbers 1 and 2 (48YE807 and 48YE808) were built in 1938. Bridge number 1 spans the Gibbon River 4.9 miles south of Norris

Junction. It is a steel, I-beam continuous girder type, with spans of 35 feet, 40 feet, and 35 feet lengths, totaling 110 feet in length from end to end. The bridge is constructed on stone masonry abutments and piers with reinforced concrete deck and steel guardrail, and has a design load of 15 tons. The deck is 29 feet 2 inches wide accommodating a roadway measuring 24 feet from curb to curb.

The Gibbon River Bridge No. 2 crosses the river 6.1 miles south of Norris Junction. The bridge is a concrete deck girder structure with encased steel beams on the outside and masonry piers and abutments. Three spans with a maximum span length of 39 feet 8 inches join to extend a maximum length of 104 feet from end to end. The deck width is 30.7 feet while the bridge roadway from curb to curb is 26 feet, and its design load is 15 tons. The bridge piers are on a skew and the bridge curves 8 degrees 30 minutes to the left as one looks north. This curve creates torsion and increases the stress on the girders.

Abutments and piers of both bridges are masonry and have spread footings which rest on very tightly packed gravel.

The culverts and retaining walls along the Grand Loop Road are also part of the historic district and contribute to its significance. Seven different types of culverts have been identified along this stretch of highway and are thought to have been built in 1928 (Lingo1996). Type A, the most common type (57 occurrences), is characterized by a straight rectangular stone headwall whose large shaped stones are mortared into place around a single culvert pipe of metal, clay, or concrete. Seventeen of the culverts were a type B, drop inlet structures of about two feet in depth. The culvert itself may be concrete or steel pipe centered in headwalls similar to type A with generally coursed, mortared, rough-cut stones. Types D and E are unique double culverts constructed of randomly coursed stone. On one side of the road there is a central stone headwall with two perpendicular stone sidewalls; the opposite side has a single headwall only. One single culvert (type F) consists of a concrete pipe and one stone masonry rectangular headwall; a double log header supports the weight of the road itself. Two culverts (type G) have an arched opening created by stones set on end in a radial pattern above the drain pipe. Some of the tops of the type G headwalls are curvilinear, while others are flat.

The retaining walls along the roadway are one of the most visible and aesthetically pleasing remnants of the historic road building period. The retaining walls on the banks of the Gibbon River were built in the 1890s with subsequent repairs being made around 1907, and 1914. They are uncoursed, unmortared battered gray stone rubble walls, of varying sizes. These walls have sustained some damage in the recent several years of record high water. There are five Gibbon Canyon retaining walls but only one is visible from the Grand Loop Road.

The retaining walls in the viewing area of Gibbon Falls were constructed of a combination of cut and uncut mortared stone by early contractors between 1928-1931. The walls reach a maximum of fifty feet above the river. Some sections of wall are alternating height bays of crenellated, coursed, mortared cut stone which serve as a guardrails. These walls have received damage from being struck by vehicles and from the 1959 earthquake. Also of note is the rough cut rectangular stone masonry curbing along the entire road pullout in this area.

Another retaining wall along the Gibbon River is approximately 210 feet long and a maximum of fifty feet high at the highest point. It consists of crenellated bays of rough cut mortared stones, with a battered drylaid wall of smooth stones and was likely constructed in 1914. The guard wall on top of the retaining wall has also sustained damage from being struck by vehicles.

The Beryl Springs cribbing (12-inch diameter wood logs with small stone rubble fill behind) was built in 1962 and serves as a 168-foot long and 12-foot high retaining wall at the north end of the Beryl Springs bridge. Some of the logs are in a state of decay.

Table 2 describes the archeological sites and road structures that potentially could be affected by road reconstruction, and lists their National Register eligibility and probable project effects.

Ethnographic Sites. The Nez Perce Trail passes south of Madison Junction, but no ethnographic sites have been documented within the project area.

Cultural Landscape. The Grand Loop Road represents the continuation of a design philosophy in which the designed features impart to the visitor a feeling of "blending with nature." The road and its features were considered part of the landscape rather than separate from the landscape. The design of the Grand Loop Road system was intended to provide the visitor with scenic and interesting views as well as access to the geysers and other places of special beauty in the park. As the road winds along the Gibbon River between Madison and Norris, it traverses a pleasing variety of scenery, including grassy meadows to mountainous topography with vegetation that ranges from open meadowland to a transition zone vegetation dominated by lodgepole pine. The steep walls of the Gibbon River canyon and the river rapids form a dramatic counterpoint to the open pastoral views in Gibbon Meadows. The historic roadway features (bridges, culverts, and walls, etc.) are done in a rustic style using native materials and a design that complements the natural features. The road is part of the landscape.

SOCIOECONOMIC ENVIRONMENT

General

Yellowstone plays a prominent role in the social and economic life of the greater Yellowstone area. Gateway communities of varying sizes have developed outside the park's five entrances — Cody, Dubois, and Jackson in Wyoming and Cooke City/Silvergate, Gardiner, and West Yellowstone in Montana. The Montana gateway communities are on the immediate border of the park or within a few miles; the Wyoming gateway communities are an hour's drive or more from the park's boundary.

The gateway communities provide food, lodging, and gasoline and other automotive supplies/services as well as souvenirs and other goods and services to the motoring public. The availability of services varies from community to community. Quantity and quality of services depend on the size of the community and the volume of traffic passing through. The gateway communities are relatively small. Their populations range from less than 150 permanent residents for Cooke City and Silvergate combined to not quite 8,000 for Cody. In 1990 West Yellowstone had a population of 913 people.

The link between tourism and the gateway communities is evident, especially in West Yellowstone. Relatively large numbers of motels, restaurants, and souvenir shops catering to travelers are located in West Yellowstone and other gateway towns. The economic viability of gateway communities depends heavily on the recreation and tourism traffic that is generated by Yellowstone and other public recreation destinations. The flow of traffic through the park, in turn, depends on the maintenance and improvement of the park's road system. Gateway communities understand this relationship.

Throughout the greater Yellowstone area, public lands provide the basis for much of the economic activity (recreation, mining, forestry, and agriculture) that occurs within the region. Over the last few years many communities in the area have experienced a structural change in their economies. The communities are less dependent on extractive industries (mining, timber, etc.), which are subject to boom and bust cycles.

Within the park itself economic activity is concentrated at six locations along the road system: Fishing Bridge, Lake Village, and Bridge Bay; Canyon Village; Tower/Roosevelt; Mammoth Hot Springs; Old Faithful; and Grant Village. A wide range of services including food, gas, lodging, transportation, horse rental, and medical services are provided by the private sector through concession arrangements.

Peak summer NPS employment (permanent and seasonal) averages approximately 730 persons. Most of these people and the majority of the nearly 3,200 employees hired by concessioners during the summer season live in the park. Park staff and concessionaire employees make up several small communities centered around the above park locations plus six other smaller developments. These communities have evolved because of the demand for goods and services within the park by the visiting public, the administrative and operational needs of the park, and the distance and isolation from usual services. The large volume of visits that the park receives requires that Yellowstone be the focus of much of the economic activity in the area.

Less than 2 percent of Yellowstone National Park is developed. Park infrastructure includes utilities, trails, roads, employee housing, administrative headquarters, and visitor services facilities in various areas throughout the park. Total developed area has decreased in recent years, as park managers have removed some developments from resource areas and other developments have been consolidated.

Visitor use and economic activities supporting this use are highly seasonal. June, July, and August are the months of highest use; with 50 percent of the park's visitation arriving in July and August; the shoulder-season months, May and September, receive less use but the volume is still significant. Use in the winter months is relatively low, accounting for about six percent of the overall visitation. In the late 1980's and early 1990's, winter use grew ten to 15 percent annually, reaching over 140,000 in 1992–93. In 1996-97, winter use had dropped to approximately 113,000. The 1996 SADT 4,505 and the AADT for the same year was 2,151.

In 1996 the park received in excess of 3 million recreational visits, and visitation over the past five years has ranged from 2.9 million to 3.14 million. These visits represented more than one million vehicles entering the park and using the road system within the six-month period from May through October. The West Entrance accounted for approximately 37 percent of the vehicles, and the North Entrance provided access for approximately 19 percent of the total. The Northeast Entrance was the least used, pro-

viding for little more than one-twentieth of the total traffic entering the park. The remaining amount was split between the south and east entrances, with the south receiving slightly more.

The five park entrance roads lead into the Grand Loop Road, the main road providing access to the interior of the park. The seasonal nature of park use is dictated by climate and local weather patterns. During the winter season snow blankets most of the road system. Most park roads are closed from approximately November 1 to April 30. When covered by snow the road system is available for snowcoach, snowmobile, and cross-country ski use. The only exception is the road through the park that connects Gardiner and Cooke City, Montana. This section is kept open by plowing because it is the only winter road link for the towns of Cooke City and Silvergate. Use of the park during the winter season is becoming more important for some gateway communities, especially West Yellowstone.

Nearly 329 miles of park roads are open to the public. They are required to accommodate various types of vehicles. Everything from bicycles to commercial tour buses use the roads. The park is prohibiting commercial bicycle tours in 1999 for all road segments that have not been upgraded to the 30-foot park standard road width. Great stress is also placed on some segments of the road system by the large numbers of tour buses that regularly come to the park. A fully loaded tour bus can have axle weights exceeding those of a loaded logging truck. Commercial truck traffic is prohibited from using park roads as thoroughfares. However, some large trucks and equipment must pass through the park to provide the goods and services required by the visiting public. Maintaining the facilities and roadways in the park also requires equipment, vehicles and personnel using these same travel routes. Emergency vehicles such as fire trucks, ambulances and tow trucks are also road users. Winter use adds snowmobiles, snow coaches, grooming equipment, and other tracked vehicles on the snow covered roads, and snow plows, snow blowers and graders on plowed roads. Snow removal to open the roads for the summer season requires a variety of snow removal equipment to remove snow depths up to 20 feet and the ice layers at pavement level.

Most segments of the road system are paved to a width of 20 to 24 feet with no discernible shoulders. Recreational vehicles up to eight feet six inches wide with side mirrors extending out another 18 inches on each side are common throughout the park. Automobiles, recreational vehicles, and pickup trucks are the most common vehicles on the roads. Visitors frequently bring their recreational vehicles, house trailers, or boat trailers into the park. Much of the road system is in dire need of repair and/or reconstruction. The existing poor road condition is the result of a variety of factors. Increased number of vehicles, heavy vehicles, poor road materials, inadequate ditching and drainage structures, winter use that contributes to the frost depth, inadequate width to protect against rockfall, changing thermal features, increased debris flows after the 1988 fires destroyed vegetation, increased encroachment of the river during spring runoff, the lack of cyclic maintenance including chipseals, overlays, ditching and shoulder maintenance, inadequate and poorly constructed pullouts and age have resulted in a potholed, frost heaved, soft, cracked, rutted roads. Rockfall, weather, wildlife, and other unforeseen conditions also add to the hazards of driving.

Accidents occur more frequently on two lane, narrow, winding roads with poor surface conditions and obstructions close to the travelway. The present road system has

numerous segments that meet all of these criteria. The guidelines in the Park Road Standards present design criteria to provide a safe travel route for visitors. Emphasis is placed on width to accommodate vehicle numbers and types, and grades, sight distances, and consistency criteria are presented to address safety concerns.

Traffic patterns that are hard to equate in normal traffic terminology include vehicles parked in the middle of the road, doors open and driver and passengers by the side of the road or in the woods observing wildlife. One car becomes two, two becomes three, and soon there is a traffic jam more commonly known in park terminology as a wildlife jam. Designing pullouts to allow the traffic to pull off the road to observe the wildlife is difficult when the feature is moving. The road is the parking area. The narrower road widths do not provide a width that allows the traffic to move to the shoulder and still allow other vehicles to travel through the congestion. The lack of a shoulder also does not provide a safe area for pedestrians to observe wildlife. In an attempt to pull to the side of the road, vehicles destroy vegetation as well as damage the road edge. Animal jams can sometimes result in gridlock of the roadway as well as create hazards from having vehicles stopped in areas with poor sight distances.

West Yellowstone

The gateway community of West Yellowstone would be the most affected by the proposed "Madison Junction/Norris Junction road improvement project". Other gateway communities would be affected only slightly because of their distance from the construction area. Visitors entering the park via Jackson, Cody, Cooke City/Silvergate, and Gardiner could avoid the construction area and still visit many of the most visited sites and areas of the park.

Yellowstone is accessible from the southwest and north through West Yellowstone on U.S. 20 and U.S. 191, respectively. The town is adjacent to the western park boundary. Tourism is the mainstay of the West Yellowstone economy. Most economic activity in the area is directly or indirectly dependent upon providing goods and services to park visitors. This thriving industry also depends on a functioning and well-maintained road system within the park. The public has come to expect ready and safe access to the natural wonders of the park, and the West Yellowstone community has come to depend on the continuing flow of visitors through the park. The large volume of visitors using the west entrance enables West Yellowstone to support a quantity of businesses (gift shops, motels, restaurants, service stations, etc.) that is well out of proportion to what its permanent population could support.

Only about six percent of all park visitors come in the winter. However, the West Entrance receives a substantial proportion of this total. In 1996-97 the West Entrance recorded more than 56,000 recreation visits during the winter season from mid-December to mid-March, about five percent of its annual total, but about 50 percent of the park's winter total. The community of West Yellowstone is attempting to increase its economic stability by promoting the town as a winter gateway to the park.

The marked difference between summer and winter visitation emphasizes the importance to the West Yellowstone economy of a flow of visitors during the summer travel season. A successful summer season is critical to the economic viability of the town.

Madison To Norris Road Conditions And Use

The Madison to Norris section of the Grand Loop road is the major west to north connector in the transportation network in the park. The road provides access to various natural features along this route as well as provides opportunities for hiking, wildlife viewing, fishing, picnicking, snowmobiling, and other recreational activities. The road segment and the Madison and Norris areas do not offer the wide range of economic activity provided at the other developed areas such as Old Faithful. The road from Madison to Norris is an integral part of the Grand Loop transportation system for both the visitor traffic as well as the support system of suppliers, vendors, emergency services, administrative, maintenance and other support functions provided by the park concessionaires and the National Park Service. Visitor use and users are well documented in various studies, and design standards such as the NPS Road Standards document also reflect this emphasis. Other users of this road segment are included to provide a more complete look at the users of this road. The concessionaires must restock their food service, grocery operations and gift shops almost daily during the summer season. Trucks and vans ranging from ½ ton to 80,000 lb., 8 to 8.5 feet wide and 15 to 70 feet long serve these functions. Operational functions such as the delivery of mail, laundry, furniture and auto parts must also travel this route to provide these services.

Park Service support includes operations such as garbage pickup, trail and overlook maintenance, hazard tree removal, snow plowing, road maintenance activities such as pothole patching, ditch cleaning, chip sealing and overlaying, and grooming for snowmobiling. Road maintenance includes the hauling of aggregates, asphalt, and the graders, laydown machines, and rollers to place this material. Due to the limited construction season in this mountainous climate these activities must be performed during the same time as high visitation. This work often disrupts traffic flow and requires coordination of both the park visitors' safety as well as the safety of the workers. The present road creates hazards during these maintenance activities due to limited sight distances and the lack of adequate working room for flaggers, graders and traffic passing through the area. Grooming of the snow covered roads in the winter for snowmobiling also creates similar safety issues. The groomers often have to stop to allow snow coaches to safely pass by the equipment.

Other users of the road include law enforcement and assistance personnel, emergency response personnel in ambulances and fire trucks, repair and maintenance personnel hauling materials and equipment on transports as well as various workers and supervisors accessing their job locations. Various functions operate on a parkwide basis and use this route as the most direct route from the west side of the park to the northern areas around Mammoth.

Construction on various types of facilities such as utility plants, buildings, power lines, bridges and roads also require the movement of large equipment throughout the park including the route from Madison to Norris. Existing problems with this traffic have included wide loads that required closing the road to allow safe passage, normal loads that have been too long to make the turning radiuses around Gibbon Falls and have damaged the historic rock walls along the edge of the road and fuel spills from delivery vehicles failing to make a curve and tipping over.

This mix of vehicles has resulted in numerous accidents. Some causes include larger vehicles swerving to avoid vehicles that have crossed the centerline as a result of avoiding potholes or animals, or careless drivers who's attention drifts to view an animal or scenic view, or some driver's riding the centerline for fear of dropping off the edge of the road into a ditch. Both the visitors and park operators often incur damages and lost time when these incidents occur. Accidents on similar narrow roads have resulted in considerable property damage to dump trucks that were forced off the road to avoid a head-on accident. Accidents also occur when the road is icy. There is no recovery area if a vehicle starts to slide. Tanker Curve is rated as the worst accident location in the park, and Gibbon Falls is rated as the eighth worst accident location. The congested areas at Terrace Springs, Gibbon Falls, and Artist Paint Pots also present safety problems.

After the park is closed for the summer season in November, park service and concessionaire activities include shutting down facilities as well as preparing for the upcoming winter season. These operations often require employees to access the park on unplowed, snow covered roads. Traffic tends to form tracks that hug the center of the road in an attempt to stay out of the ditch. This travel down the middle of the road is the most pronounced on the narrower roads including the route from Madison to Norris and is another exposure to a safety hazard. Snow plowing is required to open this road in the springtime after the winter snowmobiling is finished. Snow depths range from one to six feet along the Madison to Norris route. Removing the winter snowload requires adequate roadway width to accommodate the snow removal equipment, to provide snow storage areas, and to allow for proper drainage during the spring runoff period. The existing snow removal operation has difficulty with the present lack of storage, lack of road width to provide safe passage of two way traffic including large snow removal equipment as well as inadequate drainage structure to prevent the road base from becoming saturated and losing its ability to support traffic loads. The plows have often gouged large sections of pavement or sunk through the pavement when the road structure underneath failed to support the load.

Pullouts and passing zones are also needed to allow for the variable speeds of the travelers, users and the power of the various types of vehicles. The existing road has a very limited amount of passing zones and the pullouts are undersized, have steep grades dropping off the road, and are difficult to see and use until the driver is almost beyond the pullout. Informal pullouts have developed where adequate pullouts do not exist. These pullouts often damage resources as the edges continue to creep and expand the disturbance.

A transportation analysis (BRW, Inc. 1998) conducted to evaluate traffic movements and the level of service for the existing road and for the 24 and 30 foot width alternatives documented the present peak hour use at 311 northbound and 277 southbound vehicles per hour and projected the 2010 use at 392 and 348 vehicles per hour. The traffic flow analysis concluded that this road segment "affords no opportunity for slow vehicles to pull out of the traffic stream to allow other vehicles to see the road ahead and pass, as conflicting traffic volume allows." Regardless of the event that causes the front vehicle to stop or slow down and regardless of the width of traveling vehicles, the current road width causes delays that continue until the front vehicle moves. The report summarized that the narrow width and winding alignment of this road result in poor operating conditions. This in conjunction with the volume of traffic result in a level of service

E, reflecting very congested flow with a high probability of long delays to road users. The traffic analysis also noted that a 30-foot road width would result in a level of service of D. Level of service D represents the upper range of traffic volumes that can be accommodated while maintaining stable traffic flow.

ENVIRONMENTAL CONSEQUENCES

OVERVIEW

The National Environmental Policy Act (NEPA) requires that environmental documents disclose the environmental effects or consequences of a proposed federal action and any adverse effects that cannot be avoided should the proposed action be implemented. In this instance, the proposed federal action involves road improvement between Madison Junction and Norris Junction, as described in this document.

The intent of this section is to provide an analytical basis for comparison of the alternatives and the impacts that would result from implementation of these alternatives. Impact topics have been selected for the analysis based on the potential for effects on significant resources and other key issues identified during planning. This section is based on scientific and analytical review of information collected by the National Park Service and provided by other agencies. Expected impacts are described for each of the three alternatives considered.

Regulatory guidelines for implementation of NEPA require an analysis of the cumulative effects of a proposed action as defined in 40 CFR 1508. These guidelines state that a cumulative effect is the effect on the environment that results from the incremental effect of the action when added to other past, present, and reasonably foreseeable future actions.

ALTERNATIVE A: RECONSTRUCT EXISTING ROADWAY ALIGNMENT TO A 9.2 METER (30-FOOT) PAVEMENT WIDTH WITH GIBBON FALLS TO TANKER CURVE REALIGNMENT

Natural Resources

Soils and Vegetation. There would be approximately 26 hectares (64 acres) of disturbance to soils and vegetation along the roadside during road reconstruction. Construction of new or relocation of existing parking areas/pullouts outside of the existing road prism would impact an additional 2.2 hectares (5.4 acres). The majority of all disturbance would be to lodgepole pine forest and associated understory species. Approximately 1.9 hectares (4.8 acres) of land would be recontoured and revegetated to establish a more natural landform following the removal of the Gibbon River canyon segment of road.

The large slope/cliff face opposite the Gibbon Falls overlook parking area would be further excavated to improve the stability of the slope. Approximately 120,000 cubic meters (157,000 cubic yards) of material would be removed. Some blasting would likely be necessary. A net quantity of about 340,000 cubic meters (450,000 cubic yards) of excavated material would be generated by the entire project. This material would first be incorporated into the roadway fill areas or used to reclaim/recontour previously disturbed sites. Any excess material would be disposed of at one of the designated disposal sites or stockpiled at a designated site for future road construction projects.

A total of 18 individual rare plant sites would be affected. Approximately 0.2 hectare (0.5 acre) would be lost. Four of the rare plant sites contain plant species (*Carex flava, Carex livida, Cryptantha spiculifera, Eriophorum viridicarinatum, Lonicera caerulea var. caurina, Eleocharis tenuis var. borealis, Epilobium palustre, Muhlenbergia glomerata and Selaginella selaginoides*) unlikely to reestablish or recolonize areas disturbed by road construction. One of the more sensitive sites contains the population of *Cryptantha spiculifera*. This population occurs on three sites on the bare thermal deposits in the vicinity of Terrace Spring and is the largest known population in the park. Only a small portion (48 square meters/516 square feet) of one site immediately adjacent to the road would be affected. Similarly, impacts would occur to only portions closest to the road of the other rare plant sites, with the exception of 9 sites that would be entirely lost. Seven of these sites contain *Carex cusickii* and/or *Juncus tweedyi* which often occur in sites which were previously disturbed by road construction. Two site contain *Dichanthelium acuminatum* and *Heterotheca depressa*, which are associated with thermally influenced ground.

Topsoil would be salvaged during construction for later revegetation work. No imported topsoil would be used in reclamation. Reclamation and revegetation efforts would follow the Yellowstone National Park policy on vegetation management for construction (see Appendix A). Borrow and aggregate materials from sources outside the park would be heated (or the source would be certified weed-free), and construction equipment would be carefully checked to avoid the importation of exotic vegetation. Indigenous native plant materials would be used for revegetation, and areas disturbed by construction would be monitored for early detection and removal of exotic species. A revegetation plan has been prepared for these areas. Standard, approved erosion control techniques and structures such as silt fencing would be implemented during and following construction.

Hydrothermal Resources. Along some sections of the roadway, thermal features are close to and on both sides of the road. To avoid impacting these resources where possible, steepened side slopes and rocked ditches would be used to keep fill materials from covering the features. Road reconstruction would still affect portions of 7 thermally influenced areas (primarily hot ground as defined through infrared thermography and some small unvegetated thermal seeps) encompassing about 0.1 hectares (0.3 acre). These areas are not associated with thermally influenced wetlands. In areas of high thermal heat flow and where thermal features would be located in proposed cut or fill areas, special road design features, such as thermal design pavement structure over fill areas and underdrains/subexcavation in cut slopes, would be included to help control heat dissipation and water flow. Further investigations during design would pinpoint thermal sites to help develop avoidance or mitigation measures.

There would be no impacts to Beryl Spring. Red Iron spring would no longer be impacted by the existing road due to the road realignment out of the Gibbon River canyon and restoration of that segment of road. At Terrace Spring, about 528 square meters (0.1 acre) of thermal ground would be impacted by road work. The thermal pool adjacent to the road would be avoided by widening the road away from it. However, a new culvert would be placed, and the constructed drainage ditch would be removed which would allow re-establishment of a more natural drainage pattern of numerous dynamic runoff channels. Care would be given to maintaining a normal water level in Terrace Spring during culvert placement. The Terrace Spring area is subject to heavy use, includ-

ing trampling by visitors and informal parking adjacent to the road. The relocation and expansion of parking to better access and direct visitor use at the spring should reduce these impacts. Two thermal seep runoff areas would be restored in the canyon.

In addition, 5 thermally influenced wetlands encompassing approximately 0.5 hectares (1.2 acres) would also be impacted. Many of these areas have been altered by the existing road. (Thermal wetland acreage is also identified under wetland impacts, see following "Water Resources and Wetlands" section).

Wetlands and Other Waters of the U.S. Reaches of the river are currently affected by the presence of the road and roadway fill due to confinement of the channel and overbank flow areas. Removal of the road between Gibbon Falls and Tanker Curve and the associated roadway fill and riprap within the river would allow the restoration of a more naturally functioning river system and hydrological patterns. This would also promote the development of wetlands in deposition areas along the channel, much like those that exists in unimpacted reaches of the river. Select placement of large rock may be used in some areas to protect newly exposed stream banks from erosion to allow vegetation to become reestablished. A U.S. Army Corps of Engineers 404 permit would be obtained to remove material from waters of the United States.

In general short-term local siltation and turbidity of the river and other drainages adjacent to the roadside might occur as a result of construction activity and erosion of disturbed soils before vegetation became established. Scheduling and standard erosion control measures and barriers would be implemented to prevent runoff from degrading water quality. The emphasis would be on techniques that do not need to be removed later (mulch vs silt fences). The removal of roadway fill in the Gibbon River canyon would also result in siltation and turbidity impacts, although the channel is naturally composed of rocky, less fine, material. These impacts are expected to be short-term until the river makes minor adjustments in its channel pattern. In addition, fill removal would be done during low flow periods to minimize material being washed into the river.

The preliminary engineering road designs sought to avoid and minimize impacts to wetlands whenever possible, through use of such techniques as shifting the centerline to avoid wetlands and steepening fill slopes or constructing rock walls to minimize the extent of fill. However, because of the prevalence of wetlands bordering the road, the increased road prism width and associated cut or fill would result in impacts to some wetlands on both sides of the road. A total of 27 individual wetlands would be affected. The total area of wetlands lost would be approximately 0.96 hectares (2.4 acres). The majority of these wetlands are classified as palustrine emergent wetlands, either saturated or seasonally flooded. Five of these are thermally influenced wetlands totaling about 0.5 hectare (1.2 acre). The design and location of all but one new or relocated parking area/pullout would avoid wetlands. The one exception, the Artist Paint Pot parking area, would be relocated and would minimally impact a wetland along the access road, but would allow reclamation of a similar amount of wetland. The total area of wetland mitigation for unavoidable impacts would be accomplished through restoration of a minimum of 0.96 hectares (2.4 acres). Much of this restored wetland would occur in the Gibbon River canyon.

Fisheries and Aquatic Resources. Meehan (1991) reviewed extensive literature and described the changes that may occur in streams as a result of roads. Direct effects may

include the acceleration of erosion and sediment loading. Such changes can affect fish habitats. Other changes may include changes in rainfall-runoff relationships, hillslope drainage.

Runoff characteristics and important sources of flow may be altered in both a short-term and long-term basis. Many thermally influenced wetlands are within 200 feet of the roadway, and are responsible for the temperature and chemical effects which increase the river's productivity. In general, short-term effects will include increased disturbance to some riparian soils and potential increases in runoff due to the removal of road fill and exposed slopes until vegetation becomes established. Impacts to wetlands would be minimized. Wetland mitigation for unavoidable impacts would be accomplished through restoration of a minimum of 0.96 hectare (2.4 acres) of previously disturbed wetlands in the project vicinity. This would include restoration of about 0.5 hectares (1.2 acres) of thermally influenced wetlands. Restoration of a more naturally functioning river system in the Gibbon River canyon would also promote the development of wetlands in deposition areas along the channel, much like those that exists in unimpacted reaches of the river.

- Disturbance to soils and vegetation may impact aquatic flora and fauna by degrading water quality. Turbidity and siltation reduce benthic invertebrate communities (Waters 1995). These invertebrates, food sources for fish, are observed at lower densities in streams subject to sedimentation. Scheduling and standard erosion control measures and barriers would be implemented to prevent runoff from degrading water quality. Removal of large rock used to stabilize the river bank adjacent to the existing road, in the canyon area that is to be rehabilitated to a natural state, will cause the stream channel to migrate slightly in some locations. This is expected to cause an increase in siltation and turbidity in the short-term. The resulting turbidity and siltation could lead to the temporary reduction or loss of fish populations in some segments of the river. Accumulations of fine sediments in pools reduces wintering habitat for adults, and can reduce feeding and growth through loss of visual capabilities and orientation. These impacts are expected to be short-term until the river makes minor adjustments in its channel pattern. In addition, fill removal would be done during low flow periods to minimize material being washed into the river.

Wildlife. Food and garbage would be managed to ensure that it was not available to bears or other wildlife. The presence of humans and associated food attractants can lead to wildlife/human conflicts, in particular conflicts with bears, which sometimes requires removal of the animal from a roadside. Orientation sessions, including information on bears, would be conducted for construction personnel to reduce the potential for conflicts at construction sites and along the project route.

Road kills would continue to contribute to wildlife mortalities. However, the number of wildlife mortalities on this road are expected to remain low. Maintenance of existing 35 mph posted road speeds, continued curves throughout the alignment that would temper speeds, and addition of pullouts for slower traffic should minimize the potential for road-kills. Some increase in vehicle speeds could occur due to a smoother road surface, and some increase in wildlife mortality is anticipated under this alternative.

Approximately 28 hectares (70 acres) of wildlife habitat adjacent to the road would be impacted by construction. Of this acreage, approximately 6.5 hectares (16.1 acres) of new disturbance would occur along the realignment segment of the road. Areas impact-

ed outside the proposed road (e.g. cut/fill slopes) would be reclaimed/revegetated. It is likely that wildlife would be temporarily displaced from habitat adjacent to the road due to construction equipment and activity for the duration of the project. Bears are predominantly active during evenings, night, and early morning time periods. Nighttime work would occur, overlapping the active time of bears. Most observed bear activity along the road corridor was reported in spring and summer seasons, with fewer reports recorded during the fall. Most construction would occur during the late spring to fall months, thus somewhat overlapping the time when bears are most active. The road realignment section would probably be of some benefit to bears by relocating the road to slightly lower quality bear habitat than exists along the existing canyon alignment (32.4% medium quality summer habitat and 85.8% high quality fall habitat vs 50% medium quality summer habitat 86.9% high quality fall habitat respectively). Realignment would also move that section of road out of the canyon/river bottom to an adjacent bench area which would also serve to reduce impacts to bears use in the canyon and allow reclamation of about 1.9 hectares (4.8 acres) of the existing road within Gibbon Canyon.

Impacts to elk, bison or other wildlife populations are anticipated to be minor because wildlife mortalities are expected to remain low, habitat loss would be limited to areas immediately adjacent to the road, potentially disturbing construction activities would be temporary and confined to the road corridor, all staging or material storage areas would be confined to previously disturbed areas along the road corridor, and construction would not occur during the winter season.

Some wetland habitat for spotted frog, western (boreal) chorus frog, western (boreal) toad, and blotched tiger salmander would be lost. Minimizing impacts to wetlands and aquatic areas along with restoration of wetlands and a section of the Gibbon River would minimize effects on these species populations and habitat. Loss of habitat for (northern) sagebrush lizard, rubber boa, and western terrestrial (wandering) garter snake would occur, but would be limited to areas immediately adjacent to the road.

Construction activities along the road corridor would temporarily displace various bird species. Where previously undisturbed ground was developed, a permanent loss of habitat would occur. Black-backed and three-toed woodpeckers are nomadic in their movements and excavate new nesting cavities each year. Consequently road construction should present little problem for these species. Some nesting birds could be displaced by tree cutting activities that occur prior to July (the typical end of their nesting period). Common loons have not been recorded in the project vicinity and there is little potential habitat; consequently, there should be no effect on this species. The great gray owl and boreal owl have not been documented along this section of road, but suitable habitat is present. Reconstruction of the road (widening/smoother surface) may allow traffic to move faster which would likely increase road-kills of owl species in general. Maintenance of existing posted road speeds, continued curves throughout the alignment, and addition of pullouts for slower traffic should minimize the potential for road-kill to owl species. There should be no impact to harlequin ducks since they are rarely found in this area. Northern goshawks are also rarely observed in this area and are unlikely to be affected. Trumpeter swans are found along specific areas along the Gibbon River primarily between mid-October through February. It is also likely that construction work would end for the season when the park closes the road for the winter, typically early November. Consequently, there would be only a short, possibly 2

week, potential overlap between the construction period and swan use in the area. No impacts to trumpeter swans are expected.

Air Quality. There would be minor impacts on air quality or visibility in the park or region; effects would be temporary and limited to the duration of construction. Dispersed dust and mobile exhaust emissions would be caused by truck traffic and equipment activity. Dust and hydrocarbons would not be in sufficient quantities to degrade park air quality. All contractor activities would comply with state and federal air quality regulations, and contractors would operate under applicable permits.

Threatened and Endangered Species

Grizzly Bears. Park roads within or adjacent to bear habitat can effect bear populations, both directly and indirectly. Direct effects include human-caused bear mortality (including road-killed bear mortality) and loss of habitat that is paved during road and pulloff construction. Indirect effects include reduction of habitat effectiveness due to human-caused displacement of bears from habitat adjacent to road corridors. Bears may also be indirectly affected by roads through habituation to humans and other behavior modifications.

When comparing the Madison Junction to Norris Junction road segment to other sections of road within the park, it is an area with a very low frequency of bear sightings (National Park Service Bear Management Office, unpublished report 1995). However, it's existence entirely within the Firehole/Hayden BMU (fifth highest producer of grizzly bear females with cubs), does emphasize the importance of the surrounding area on a broad scale. The road segment runs continually along the Gibbon River, a low elevation area providing lush vegetation and winter-killed ungulate carcasses in early spring. Females with cubs emerging from dens may depend on these temperate areas until more habitat becomes snow free later in the season.

Bears may be temporarily displaced from roadside habitat by the noise and disturbance of construction activities. Human caused displacement of bears from habitat near recreational developments (Mattson and Henry 1987, Reinhart and Mattson 1990), roads (Green and Mattson 1988, Craighead et al. 1995), backcountry campsites (Gunther 1990), and recreational trails in nonforested areas (Gunther 1990), has been documented. Bears generally exhibit the strongest avoidance of occupied front-country human developments (Mattson 1990). Restrictions on construction activity at individual staging /storage areas and work sites would be implemented based on the presence of carrion and bear related activity.

Some bears would not be displaced by human activity along the road, but may become habituated to people in an effort to access habitat along the road corridor. Bears that frequent roadsides and developed areas are females with young, the segment of the population that is most critical for recovery (Knight and Eberhardt 1985). Females with young and subadult males have the highest energy requirements with the least access to quality food sources. As a result, habituation is represented more in these sex and age classes than in other cohorts (Mattson 1990). As the population nears carrying capacity, the frequency of roadside bear activity increases and thus the number of habituated animals increases. Female and subadult male grizzly bears are likely to be pushed out of the higher quality secluded habitat by more dominant male bears. The less dominant

bears are then forced to choose between a lower quality habitat in the wild or a higher quality habitat near humans. As a result, there is a disproportionately high representation of these age classes in habituated animals and hence among the animals in which management actions are required. Because habituated bears are perceived as possible threats to human safety, they are often removed from the population (Gunther 1994).

Bear-human conflicts can lead to the removal of bears by park managers due to human safety concerns. There was only 1 bear-human conflict reported along the Madison Junction to Norris Junction road segment during the 5-year period 1990 through 1994. A single adult grizzly caused a traffic jam in the Elk Park area, which is just north of the northern end of this project. These type of human-bear conflicts are caused by bears that have become habituated to people and forage within close proximity to the road. Visitors often approach these bears too closely creating an unsafe situation that requires monitoring by park personnel. This also contributes to the further habituation of bears to people. To prevent bear-human conflicts, proper sanitation of human foods, garbage, and other bear attractants by road construction workers would be required. Road construction employees would also be given orientation programs on avoid encounters and minimize disturbance of bears.

During the 10 year period 1985 through 1994, there was one female grizzly bear hit and killed by a vehicle in the Gibbon Meadows area. Some increase in vehicle speed could occur due to a smoother wider road surface, and there is the increased potential that bears could be killed following completion of the project. However, project design would undertake to minimize road-kills of wildlife by maintaining the general curvature of the road and existing speed limits.

The road realignment section would probably be of some benefit to bears by relocating the road to slightly lower quality bear habitat than exists along the existing canyon alignment (32.4% medium quality summer habitat and 85.8% high quality fall habitat vs 50% medium quality summer habitat 86.9% high quality fall habitat respectively). Realignment would also move that section of road out of the canyon/river bottom to an adjacent bench area which would also serve to reduce impacts to bears use in the canyon and allow reclamation of about 1.9 hectares (4.8 acres) of the existing road within Gibbon Canyon.

To mitigate the effect of human activity along the road corridor during and following construction activities, the following actions would be incorporated as part of the proposal.

All project-related employees, such as contract and government construction employees, will be given orientation regarding food storage, disposal of garbage and other bear attractants, and approaching or harassing wildlife.

At staging areas, no long-term food storage or garbage retention would be permitted. Only bear-proof garbage cans would be used in designated staging or construction-related sites and emptied regularly.

Employee or contractor camps would be permitted in existing developed or disturbed areas, if housing is needed for such employees within the park. Security guards would be assigned, as necessary, to contractor camp areas to help patrol for food security.

If carrion or associated bear activity are documented in the project area, use restrictions may be imposed. These restrictions may result in temporary delays or changes in work schedules for the contractor.

Project design would undertake to minimize road-kills of wildlife by maintaining the general curvature of the road and existing speed limits.

Under this alternative, with measures designed and instituted to minimize impacts on grizzly bears in the project area, construction activities would not be likely to adversely affect the existence of the grizzly bear population in the Yellowstone ecosystem.

Bald Eagle. A pair of bald eagles nest in the vicinity of Madison and have been occupying this site for many years. Road reconstruction activities would not disturb nesting eagles due to the distance from the nest site. However, the nest would be monitored when construction was taking place in the vicinity. Bald eagles are also known to use the areas around Madison Junction for foraging and roosting; however, no new impacts are anticipated. This alternative would not be likely to adversely effect bald eagles.

Peregrine Falcon. An active peregrine eyrie occurs in the vicinity of the road. The most critical time for nesting peregrines is during the incubation period. Typically, this occurs during the entire month of May, but can extend into June. Blasting during road construction in the Gibbon River canyon (Gibbon Falls to Paintpot Hill) would be prohibited from April 25 through June 15 to avoid disturbing peregrines during the incubation period. With this restriction on blasting, this alternative would not be likely to adversely effect peregrine falcons. In addition, the nest would be monitored during construction in the nest vicinity.

Whooping Crane. In recent years one to two whooping cranes have summered separately in the backcountry in the southern half of the park, in areas distant from this road project. The habitat along this section of road does not represent characteristic whooping crane habitat. There are very few open meadows, and the meadows are too dry to support whooping cranes. Since this species is not considered present in the area and little if any potential habitat exists, the whooping crane would not be affected by this alternative.

Gray Wolf. While some wolves temporarily displaced from roadside habitat by noise and disturbance of construction activities, wolves travel widely and have not appeared to alter their habits even when being viewed by hundreds of visitors. The project stipulations outlined for grizzly bears would include an orientation on wolves. Similar to bears, if wolf activity occurs in the project area, restrictions on a contractor's activities may be imposed. The proposed project would not be likely to adversely affect gray wolves.

Cultural Resources

A summary of the potential project impacts on prehistoric and historic sites, ethnographic sites, and cultural landscapes is included in table 2. Because most of the sites recorded in the project vicinity are outside of the area of potential effect (APE), they would not be affected by construction or indirect project effects and will not be discussed here.

TABLE 2. DESCRIPTION OF CULTURAL RESOURCES

Site Number & Description	Project Effects	Further Compliance Needed
48YE365 Prehistoric archeological site is eligible for the National Register of Historic Places.	Alternative A: **No effect** of using excess materials to create nearby berm. Site would be avoided. Alternative B: **No effect** of using excess materials to create nearby berm. Site would be avoided.	Alternative A: No further compliance necessary. Alternative B: No further compliance necessary
48YE723 The Iron Spring Quarry with associated structures and artifact scatters dating to the early 1900s; Quarry component NR Eligible under Criterion D with trash deposits and road segments non-contributing to eligibility.	Alternatives A and B : Site proposed to be used for storage and wasting of excess excavated material. With mitigation, **no adverse effect** . Alternative C (no action): **No effect.**	Alternatives A and B: HAER documentation completed. SHPO/ACHP review of EA.
48YE807 & 48YE808 Gibbon River Bridges Nos. 1 and 2, built in 1938. Both are NR eligible and contributing elements of the Grand Loop Road Historic District.	Alternative A : removal of one side of the abutment stonework, expansion of the bridge deck over existing stone piers, and reconstruction of the abutment stonework would, with compatible design, result in **no adverse effect. No adverse effect** of Alternative B; **No effect** of Alternative C.	Alternative A: HAER documentation completed. SHPO/ACHP comment on proposed widening process and concurrence of effect. Alternative B: SHPO/ACHP review of project description, design, and concurrence of effect.
48YE865. Multi-component site containing a prehistoric lithic scatter and historic remains. The site is eligible for the National Register. Historic component does not contribute to site eligibility. Portions of the prehistoric component (south side of road within right-of-way) are non-contributing to eligibility.	Alternative A : Road widening would be confined to the non-contributing portions with construction activity monitored, **no adverse effect.** Alternative B : construction activity monitored, **no adverse effect.** Alternative C (no action): **no effect.**	Alternatives A and B: SHPO/ACHP review of and concurrence on effect of undertaking on contributing and non-contributing portions of site.
48YE866. Multi-component site: prehistoric lithic scatter and historic dump. Both components are ineligible for the National Register.	Alternatives A-C not applicable.	none
48YE867 Multi-component site: prehistoric lithic scatter and historic artifact scatter associated with historic road construction. Both components are eligible for the National Register.	Alternatives A and B: site to be used for material storage and staging area. Data Recovery Plan approved by Wyoming SHPO and ACHP. Alternative C (no action): **no effect.**	Alternatives A and B : Data recovery in 1998 and SHPO/ACHP concurrence on effect of undertaking on site.
48YE768 CCC dump is eligible for the National Register.	Alternatives A and B: Site proposed to be used for stockpiling of topsoil. With mitigation, no adverse effect. Alternative C (no action): **No effect.**	Alternatives A and B: documentation completed. SHPO/ACHP review of site protection measures and concurrence of effect.
Mesa Burn Pit 3	Alternatives A and B: site proposed for use in stockpiling of topsoil. No effects known at present. Alternative C (no action): **no effect.**	Survey uninventoried areas. Section 110 and 106 compliance would be completed for any sites discovered.
Artist Paint Pots area	No effects known at present.	Survey areas lying outside previous inventory if needed. Section 110 and 106 compliance would be completed for any sites discovered.

Designs for road improvements, including pullouts, staging, materials source, materials storage areas, parking, and road alignments have been modified to avoid affecting previously identified archeological sites to the extent possible. Some of these sites have been determined to be ineligible for the National Register because of their ephemeral nature, lack of research potential, and/or loss of integrity (see table 2). Mitigating and protective measures have been included in the text describing the alternatives for eligible sites that might be affected by the project. Further actions required to complete Section 106 compliance for this project are also described in table 2.

To prevent adverse effects on National Register eligible properties, data recovery plans detailing mitigating measures have been developed for National Register eligible sites that would be affected by the project. The data recovery plans have been submitted to the Wyoming SHPO and the ACHP for review and comment. Data recovery or other mitigation and full documentation would be completed before construction was initiated.

Prehistoric Archeological Resources. Use of excess materials to create a berm between the Madison Campground and the edge of the road would not affect site 48YE365.

Because of topographic constraints, several archeological sites could not be avoided under this alternative. The prehistoric components of three multi-component (containing both prehistoric and historic materials) archeological sites would be affected by this project. Multi-component site 48YE865 was previously bisected by the road. That portion of the site was destroyed and is considered noncontributing to site eligibility. The historic component of the site does not contribute to site eligibility. Road widening would be monitored to insure no new impact to this site due to construction activity.

Site 48YE866 is situated immediately adjacent to the highway and may be minimally affected by widening. However, this site lacks integrity and substantive subsurface deposits, and neither the historic nor prehistoric component is eligible for the National Register.

Both components of 48YE867, a large and important multi-component site, are eligible for the National Register. This site is also situated adjacent to the road, and would be impacted by staging, materials storage, and by redesign of an access road. A data recovery plan for this site has been approved by the Wyoming SHPO and the ACHP. The appropriate level of data recovery occurred during the summer of 1998 to mitigate effects of road construction and resulted in no adverse effect to this site.

No prehistoric archeological resources were located on the Tanker Curve reroute

Historic Archeological Resources. Site 48YE723, Iron Spring Quarry, has been determined eligible for the National Register with the historic trash non-contributing to eligibility. This site would be affected by staging, material storage, and disposal of excess excavated materials. Contributing site elements have been documented. After filling 48YE723 with excess excavation material the area would be recontoured to a natural shape. HAER documentation of the site has been completed.

Should topsoil be temporarily stockpiled at Mesa Burn Pit 2, measures would be developed and implemented in consultation with the Wyoming SHPO to ensure that this National Register eligible site (48YE768) is protected.

The historic component of site 48YE865 has been determined not eligible for the National Register.

To minimize potential resource impacts, areas affected by work at the Artists Paint Pots and proposed stockpiling at the Mesa Burn Pit 3 would be surveyed. If cultural resources are located, they would be evaluated, and mitigating measures implemented as appropriate.

The Historic Roadway System. Proposed actions under this alternative would have direct impacts on the National Register eligible Grand Loop Road, and its contributing features (stone culvert headwalls, guard walls, retaining walls, etc.) The abandoned roadbed segments of the Grand Loop Road do not contribute to the road's eligibility and [see below] have been documented.

The historical significance of the Madison to Norris road derives from the overall site and setting and the long-standing function of conveying visitors to special places within the park. The importance is not in the width, alignment, surfacing, or traffic patterns, or in the road's appearance during the historic period. Work would be guided by protective and mitigation measures described in the 1994 programmatic agreement (PA) among the NPS, SHPOs, and ACHP.

As proposed in the Tanker Curve realignment, the abandonment and/or removal of a section of historic road bed would alter the road location, setting and use, and would constitute an adverse effect. Notice of adverse effect was given to the Wyoming SHPO and the ACHP, and a memorandum of agreement to mitigate the adverse effect of removal of a 2900 meter long segment of the Grand Loop Road, including 17 culverts and 3 retaining walls is being developed. The removal of one side of the abutment stonework, expansion of the bridge deck over existing stone piers, and reconstruction of the abutment stonework on the Gibbon River Bridges Nos. 1 and 2 would, with compatible design, result in no adverse effect.

Widening the existing road to a 30-foot width would affect some 82 culverts and several retaining walls and guard walls. However, as described in the PA, rehabilitated or reconstructed bridges, culverts, walls, parking areas, or other features would retain the appropriate scale and form within the natural and historic setting. All culverts have been documented using the List of Classified Structures (LCS) Single Entry Report and the Historic Building/Structures Survey Form. The documentation was reviewed by the Wyoming SHPO who concurred that the park's survey responsibilities for structures, as described in the Programmatic Agreement has been completed. Culvert headwalls that retain integrity and are visible from the road or other visitor areas would be carefully dismantled and reassembled to preserve their historic appearance. Existing or similar materials would be used for new/rebuilt culverts, and the original design and quality of workmanship would be retained. Parking area redesign and slope excavation in the Gibbon Falls area may result in the addition of stone guard walls and guard rails, but stone color and workmanship would be matched to present, documented structures.

Stone abutments of the new bridge across the Gibbon River and the culverts and walls along the new section of road would be designed to be compatible with the historic roadway. At present, extreme high water from the last two years in the area proposed for obliteration with the Tanker Curve reroute has caused a great deal of damage to the

historic stone headwalls and retaining walls, and it is uncertain whether washed-out stones could be recovered or the features repaired to their original condition.

Ethnographic Resources. There are no known ethnographic resources in the project area.

Cultural Landscape. The road was historically designed to be part of the landscape. This design philosophy continues on to the present. The Grand Loop Road represents the continuation of a design philosophy in which the designed features impart to the visitor a feeling of "blending with nature." The road and its features were considered part of the landscape rather than separate from the landscape.

Visual aspects of the cultural landscape in the vicinity of the highway would be impacted during and immediately following construction until vegetation has had a chance to grow, and rock cuts have aged and developed a patina. The design and materials used in new or reconstructed stone retaining walls and rockeries would match existing historic stonework and would not intrude on the cultural landscape.

Socioeconomic Environment

Possible disturbance to park visitors, park staff, concessionaire employees, park residents, and businesses at the Madison and Norris areas from construction activities would be temporary and only continue during the life of the project. This project would be reconstructed in three phases. For most of the construction, traffic would be maintained so businesses within the park should not be substantially affected economically. However, traffic may bunch up due to one-way traffic control measures, and these situations may result in surges of customers arriving at some business establishments at West Yellowstone. During the Gibbon Falls to the end of Tanker Curve bypass phase, there would have to be a total road closure from early August until the end of the season (approximately August 7 through November 1). Most businesses, residents, and visitors outside the park are so far removed from the construction area that even with total road closure for a portion of the project, it is not expected that they would be affected by the activities associated with this road improvement project. Tourist spending is not expected to be impacted. Experience with the Madison Junction to Biscuit Basin project indicated that impacts on businesses and individuals in West Yellowstone were minimal.

Visitors traveling through construction areas would experience short-term inconveniences. Dust, fumes, noise, and rough roads would be expected. There would be some increased hazards because of construction work. Some staging areas may intrude on visitor experiences if highly visible locations such as Gibbon Falls picnic area are used.

Visitors would encounter up to 30-minute (or possibly longer) traffic delays waiting for one-way traffic to clear. Delays from slow-moving traffic passing through active construction sites would occur. Nighttime and late-season closures would help facilitate the work and reduce the total time necessary to complete construction. Inconvenience and public safety concerns would be reduced by a public information program warning of closures, delays, and road hazards.

Although some park visitors would be inconvenienced by construction activities in the short term, visitors may be able to adapt their behavior and travel plans to avoid possi-

ble inconveniences. Multiple highway projects may be underway at one time, however construction schedules would be adjusted to minimize inconvenience. Some closures would overlap. See the cumulative effects discussion. In some instances, delays would give visitors the opportunity to get out of their vehicles and enjoy the scenery and wildlife. A variety of information sources would be employed to inform visitors, staff and businesses about construction activities. In the long run all travelers would benefit from a safer and more pleasant journeys made possibly by the proposed road improvements.

Roads in West Yellowstone and in the park that were used for hauling road-building materials would experience large volumes of heavy truck traffic during the construction period. Visitor traffic would be affected by this use within the park, and perhaps West Yellowstone, but the effect on tourist spending is expected to be negligible.

Short-term benefits would include economic gains for businesses and individuals within the Greater Yellowstone Area. Direct benefits would flow from construction related expenditures (the approximate cost of the project is $22 to $25 million)such as purchase and transport of road-building materials and employment of construction workers. Some new construction related, temporary jobs may be created within the regional economy due to this road project. These benefits would be affected by the location of the contractor's base of operations, sources of materials, and source of the labor supply. Indirect benefits would occur in proportion to the amount of direct expenditures that occur within the region and the degree to which these funds are recirculated within the regional economy.

Businesses in West Yellowstone would benefit from expenditures within the local economy by the contractors and their employees. For instance, many construction employees might stay in local motels as the rental housing market is insufficient to satisfy the demand. Some new jobs would be created within the local economy due to construction activities. These jobs and other construction-related spending by contractors and their employees would provide benefits to the local community.

Long-term benefits for visitors would include improved safety for motorists and bicyclists. As a result of this reconstruction work, the potential for accidents and vehicle damage would be reduced.

The long-term quality of visitor experiences would also improve. Better design and additional vehicle turnouts would provide more and higher quality opportunities for viewing scenery and wildlife along this road segment. Redesign of the Gibbon Falls Overlook would greatly enhance viewing opportunities at the falls and improve safety by adequately separating parking and viewing areas from through traffic.

The tourism segment of the regional economy would be made more secure by improvements to the road system within Yellowstone National Park. Park operations would improve because of reduced road maintenance costs, better access for park vehicles, and a safer roadway. Short-term costs to visitors and others would be more than offset by short- and long-term benefits.

Cumulative Effects

The analysis of the cumulative effects includes a discussion of current development plans within Yellowstone National Park and information about development plans for the lands surrounding the park within the Yellowstone ecosystem. Development plans in the immediate project area ¾ west and central Yellowstone National Park ¾ are primary factors in the analysis of cumulative impacts.

Although numerous construction and maintenance projects are planned for the greater Yellowstone area over the next 20+ years, the major emphasis of these projects is to replace, repair, and rehabilitate existing facilities that are approaching the end of their useful service life. Where new facilities are needed, they will be concentrated in and adjacent to existing developed areas to minimize the creation of new, isolated developments. Although some commitment of previously undisturbed resources is inevitable, as are some adverse cumulative effects, many of the project efforts to be undertaken involve the removal of existing development and the revegetation of other human activity scars.

Additionally, most planned construction is slated for already developed areas. Several hectares of previously undisturbed land are currently identified for commitment in construction projects in the park; lands also are slated for reclamation and revegetation, almost half of which are in the sensitive grizzly bear habitat at Fishing Bridge. In addition, reclamation of past material, spoil sites, and road scarring may become possible through the Abandoned Mine Lands Program, a cooperative effort of the state of Wyoming and the National Park Service, and other restoration efforts (see "Beneficial Development Effects" below).

The time span of development projects is also critical. This analysis primarily covers the period 1998 through 2004 and beyond as appropriate. The purpose of this discussion is to recognize the cumulative effects on resources, visitors, area residents, and staff of the Madison Junction to Norris Junction road improvement project in concert with the effects of other activities in the vicinity of the project, within the park, and on nearby lands.

Roadway Projects. Under this action, both the positive and negative impacts on natural, cultural, and socioeconomic resources associated with the original development of all the park roadways would persist. Positive effects include access to the park, enjoyment of its features, and financial expenditures both in and outside the park. Negative effects include the disturbance of bedrock, soils, and vegetation; loss, degradation, and fragmentation of habitat; temporary disturbance and displacement of some wildlife during construction; possible loss of historic and prehistoric resources; and waste production. Ongoing maintenance of the road would continue to result in the use of aggregate sources, possibly from existing sites needing reclamation within the park, as well as the disturbance of roadside soil and vegetation.

Reconstruction of the East Entrance Road began in summer 1994 and is expected to continue through 2004. Reconstruction of the Grand Loop Road between Madison and Biscuit Basin began in 1994 and is expected to continue through 1999. Resurfacing of the Northeast Entrance Road began in 1997 to extend the life of the road until it can be reconstructed. Reconstruction began for the section West Thumb to Lake Junction segment of the Grand Loop Road in 1998, with completion in 2000. Other future road

projects include Tower to Canyon, Canyon to Fishing Bridge, and reconstruction of the road between Norris and Mammoth (start in 2006). Start-up and completion dates for these projects are dependent on available funding.

Other Projects Within the Park. Other actions would be occurring in the park during the course of this action, adding to the overall cumulative impact within the Yellowstone ecosystem.

Ongoing and planned park road improvement projects including the following road segments: Northeast entrance road, Lake Junction to West Thumb road, east entrance road, Tower Junction to Canyon Junction road, Canyon to Fishing Bridge road, and the Norris to Mammoth road.

The finding of no significant impact (FONSI) for the Yellowstone Employee Housing Plan (part of the servicewide housing initiative) was signed in December 1992. Construction on some housing units is proposed each year. In 11 developed areas, approximately 125 year-round and 347 seasonal housing units would be upgraded, replaced, or newly constructed if the plan was fully implemented. Current funding levels allow replacement or rehabilitation of a few housing units annually. Work at East Entrance is completed, and one four-plex unit was constructed at West Entrance. Work began in Lake and in Tower in 1997 and was completed in 1998. The Mammoth Housing Plan was released in 1998. The concessioner is also upgrading employee housing at several developed areas.

The Development Concept Plan, Lake/Bridge Bay FONSI was signed in 1993. As noted above, housing construction is underway. The concessioner is moving ahead with plans to construct an employee RV area.

At Grant Village, housing to replace trailers may be constructed.

Development projects in the Mammoth Hot Springs area include continued housing rehabilitation (see first bullet statement above), interior renovations of several buildings, and continued work on the interior of the new garage.

At Old Faithful a number of projects are ongoing or scheduled to implement the approved Development Concept Plan, Old Faithful (NPS 1985). Planning has started to replace the aging sewage treatment plant. Housing would be constructed to replace deteriorated quarters as funds become available.

At Canyon Village employee housing would be replaced as funds become available. Under the approved Canyon lodging plan, some obsolete guest cabins have been replaced, and more will be replaced soon. A contractor's RV area may be constructed to more efficiently house contractor employees working on FLHP and other projects.

In the Tower/Roosevelt area, concessioner cabins have been upgraded and replaced in conjunction with rehabilitation of Roosevelt Lodge. Employee housing will be replaced pending funding. The water distribution system in the Roosevelt area will be upgraded.

A number of development projects are planned that would have effects in more than one area of the park.

If the Fishing Bridge campsite replacement project begins, 100 replacement campsites would be built at Canyon Village, with an additional 175 replacement sites at Norris. This project would eventually result in positive impacts on visitors and resources (see "Beneficial Development Effects" below) but at the cost of short- and long-term cumulative impacts through resource commitment, construction activities, and inconveniences to staff and visitors.

The Commercial Services Plan and EIS, will formulate and assess impacts of alternatives relating to the commercial services and facilities within and throughout the park.

The draft environmental impact statement for the bison management plan (released in 1998) is considering an alternative to construct bison management structures in the park near Gardiner.

To comply with the 1992 Leaking Underground Storage Tank Act (40 CFR 240, 281) many fuel oil tanks currently in use at residences throughout the park could be replaced after testing as a part of routine maintenance procedures.

Projects Outside the Park. A number of projects outside the borders of the park have cumulative effects on the Yellowstone ecosystem.

The Wyoming Highway Department is reconstructing 40 kilometers (24.9 miles) of U.S. Highway 14/20 (Cody Highway) between the east entrance and the east boundary of Shoshone National Forest.

Oil and gas leases exist outside the park boundaries, but currently no wells are in production. The only known potential oil or gas exploration near Yellowstone is the proposed Ruby Exploratory oil/gas well on the Line Creek Plateau, south of Red Lodge, Montana, and 53 kilometers (32.9 miles) east of the park.

The Royal Teton Ranch, north of the park's boundary, has water rights to geothermal flows from natural springs in the area of Corwin Springs, Montana. Montana's supplemental environmental impact statement on the Royal Teton Ranch development proposals was completed in late 1993 but there has been no recent activity in the area. A 151-acre tract of the ranch has been sold and transferred to the Gallatin National Forest to begin what will be the first phase of a two-phase sale, transfer, and protection of nearly 8,000 acres abutting the northern border of Yellowstone National Park.

The Firehole Land Corporation has nearly completed an 35 hectare (86.4 acres) land development in West Yellowstone, Montana, immediately adjacent to the park. The development, known as "Grizzly Park," contains an IMAX theater, a live bear and wolf exhibit, shops, and other commercial properties.

The FHWA will reconstruct 8.4 miles of the Beartooth Highway, also known as U.S. Highway 212 in Montana. The project begins at the northeast entrance of the Yellowstone National Park boundary, milepost 0.0, and it extends to the Wyoming State line at milepost 8.4.

Beneficial Development Effects. A number of resource restoration and rehabilitation projects have been noted in the above discussions. These include restoration of abandoned quarries, roads, and gravel pits in several locations throughout the park. The park has obtained funds from the Abandoned Mine Lands Program to begin this work. Pertinent to this project, the Little Thumb and Dry Creeks pits and access roads were restored in 1997. Reclamation of the abandoned Turbid Lake road is underway. The reclamation of the Ice Lake Pit may also take place as part of this project.

Power and telephone lines have been buried at Grant Village and from Mammoth to Roosevelt, and new telephone lines have been buried at many developed areas around the park. Some buried lines have been replaced with microwave systems. Burying lines provides visual benefits because of the removal of overhead lines from scenic areas. Restoration of the utility corridors also becomes possible once the poles and wires are removed.

Conversion of 5 kilometers (3.1 miles) of the Fountain Freight and side roads to trails, combined with wetland mitigation projects, has reduced the effects of the Madison to Biscuit Basin project, particularly on wildlife. The Fishing Bridge campground removal and other rehabilitation projects in the Fishing Bridge/Pelican Creek area are examples of projects that reduce the impacts of existing and proposed developments on grizzly bears. Similar projects would continue to restore areas that are no longer necessary for park management or intensive visitor use. All would certainly disturb nearby wildlife and other resources while they were being implemented, but their long-term goal would be to restore park resources such as wildlife habitat.

The National Park Service is also in the process of formulating a memorandum of understanding (MOU) with the U.S. Fish and Wildlife Service, Corps of Engineers, and the State of Wyoming to initiate wetland banking. This MOU would cover wetland actions in Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway, and would assist the Park Service in crediting wetland restoration projects against losses of wetlands in future construction projects. The MOU might not be in effect for this project. However, it would be beneficial in maintaining a positive net effect on wetlands during future projects.

Analysis Results. The cumulative effects on most wildlife species of the various actions occurring or proposed in the park would generally be localized. Although these localized effects appear to be short-term in nature, the long-term effects are unknown. Certain wide-ranging wildlife species, such as the grizzly bear, could be affected by construction projects in widely dispersed locations. However, most construction projects would occur within current development zones and along roadways, areas which bears are aware of and tend to avoid. Stringent proposed mitigating measures should ameliorate effects on these species.

Most of the projects are of a maintenance type (road rehabilitation, housing construction, sewage treatment facility), providing appropriate facilities for visitors and employees. The other projects involve rehabilitation and are a result of Yellowstone's commitment to restoring disturbed areas in the park to natural conditions as directed by NPS management policies.

In the reasonably foreseeable future, the potential exists for the projects described in this analysis, when added to the past and present projects occurring in the greater

Yellowstone area, to cause some cumulative impacts through long-term loss of habitat from construction and wildlife avoidance of developed areas and from incidental mortality.

Wildlife avoidance affects animals in two ways. There is a displacement effect when animals avoid otherwise suitable habitat because of human activities in the area. This results in a long-term loss of habitat. The other effect is an increase in animal density on the remaining habitat. Increased density can affect the ability of individual animals to survive. Fortunately, the effects of animal avoidance in the Madison Junction to Norris Junction road corridor and developed areas is not likely to be as severe as it would be in some other areas. This is because animals are more likely to avoid development in the summer, when visitation is at the maximum, and then return in the winter to make more complete use of the habitat. Because of the 1988 Yellowstone fires, there is increased habitat availability, and summer habitat is often less critical than winter habitat.

Nonmobile resources (cultural sites, vegetation, and some wildlife) have the highest chance of disturbance from the development of previously undisturbed land. However, park managers are aware of these possibilities and are taking steps to mitigate any negative cumulative impacts. These steps include data recovery plans for cultural resources as well as wetland and other natural habitat restoration on lands that are expected to be rehabilitated. These steps should lessen or completely cancel any negative impacts from this action, when considered with the other projects in this analysis, that would otherwise add to the cumulative effects on the Yellowstone ecosystem.

The cumulative effects of the various actions within the park on visitors would primarily be felt by visitors who stay a short time in one area. Their entire visit might be disrupted by construction activities. Employees and area residents could be inconvenienced for a number of days or weeks by local construction projects. However, road reconstruction could inconvenience employees for several seasons.

Park managers would consider potential road closures combined with an effective public information program to alert the public to the closures and delays. With closures, reconstruction could be completed in a shorter time, thus greatly reducing the overall delay created by additional construction seasons and the degree of cumulative effects of the project on area residents, visitors, and the Yellowstone ecosystem.

ALTERNATIVE B: RECONSTRUCT EXISTING ROADWAY ALIGNMENT TO A 7.4-METER (24-FOOT) PAVEMENT WIDTH

Natural Resources

Soils and Vegetation. There would be approximately 22 hectares (55 acres) of new disturbance to soils and vegetation along the roadside during road reconstruction. Construction of new or relocation of existing parking areas/pullouts outside of the existing road prism would impact an additional 1.6 hectares (4.0 acres). The majority of all disturbance would be to lodgepole pine forest and associated understory species. Excavation to stabilize the large slope/cliff face opposite the Gibbon Falls parking/viewing area would be somewhat less than under Alternative A; approximately 105,000 cubic meters (140,000 cubic yards) of material would be removed. Some blasting would

also likely be necessary. A net quantity of 260,000 cubic meters (340,000 cubic yards) of excavated material would be generated by the project, which would be incorporated into roadway fill areas or used to reclaim/recontour previously disturbed sites.

A total of 32 individual rare plant sites totaling approximately 0.3 hectare (0.7 acre) would be affected. Four of the rare plant sites contain plant species (*Carex flava, Lonicera caerulea var. caurina, Eleocharis tenuis var. borealis, and Muhlenbergia glomerata*) unlikely to reestablish or recolonize areas disturbed by road construction. The population of Cryptantha spiculifera in the Terrace Spring area, which is the largest known population in the park, would be avoided entirely. Impacts would occur to only portions of the rare plant sites closest to the road, with the exception of 17 sites that would be entirely lost. Sixteen of these sites contain *Carex cusickii, Eleocharis flavescens var. thermalis, and/or Juncus tweedyi* which are tolerant of disturbance and often occur in sites which were previously disturbed by road construction. One site contains *Dichanthelium acuminatum* and *Heterotheca depressa*, which are associated with thermally influenced ground and would be expected to recolonize what hot ground is not under the road prism.

Eighteen of the total rare plant sites impacted (0.2 hectare or 0.5 acre) by this alternative are along the section of existing roadway within the Gibbon River canyon. This would compare to 3 sites (0.028 hectare or 0.023 acre) that would be impacted by realignment of the road between Gibbon Falls and Tanker Curve.

Reclamation and revegetation would be similar to those described in Alternative A.

Hydrothermal Resources. As under Alternative A, impacts to these resources would be avoided where possible by steepening side slopes and paving some ditches to prevent fill materials from covering these features. Road reconstruction would impact portions of 10 thermally influenced areas (primarily hot ground as defined through infrared thermography and some small unvegetated thermal seeps) encompassing about 0.2 hectares (0.5 acres). These areas are not associated with thermally influenced wetlands. Design measures to control heat dissipation and water flow through thermal areas would be similar to Alternative A. Further investigations during design would pinpoint thermal sites to help develop avoidance or mitigation measures.

There would be no impacts to Beryl Spring. Red Iron Spring would continue to be impacted by the road, although thermal design measures would be incorporated into the road structure. At Terrace Spring, about 528 square meters (0.1 acre) of thermal ground would be impacted by road work. The thermal pool adjacent to the road would be avoided by road widening. However, a new culvert would be placed, and the constructed drainage ditch would be removed which would allow re-establishment of a more natural drainage pattern of numerous dynamic runoff channels. The Terrace Spring area is subject to heavy use, including trampling by visitors and informal parking adjacent to the road. The relocation and expansion of parking to better access and direct visitor use at the spring should reduce these impacts.

In addition, 10 thermally influenced wetlands encompassing approximately 0.5 hectares (1.2 acres) would also be impacted. Many of these areas have been altered by the existing road. (Thermal wetland acreage is also identified under wetland impacts, see following "Water Resources/Wetlands" section).

Wetlands and Other Waters of the U.S. Riverbank erosion and sedimentation through the Gibbon Canyon portion of the project area, would be reduced by constructing rock retaining walls and placing slope protection (riprap) to maintain the road structure adjacent to the river. Use of walls to contain new road fill would also minimize the placement of riprap that would extend into the river. Approximately 200 meters (655 feet) of rock walls entailing 1,200 cubic meters (1,570 cubic yards) of material, and 1,350 meters (4,430 feet) of riprap entailing 10,125 cubic meters (13,245 cubic yards) of material, would be placed along the river. About 50 percent of the road through the canyon would require walls or riprap. A U.S. Army Corps of Engineers 404 permit would be obtained to place fill within waters of the United States. Short-term local siltation of the river and other drainages adjacent to the roadside might occur as a result of construction activity and erosion of disturbed soils before vegetation became established. Scheduling and standard erosion control measures and barriers would be implemented to prevent runoff from degrading water quality. Debris from the five existing slide areas in the Gibbon Canyon (between Gibbon Falls and Tanker Curve) would be carried under the road through large culverts and into the river, periodically affecting local water quality and aquatic habitat from sedimentation and siltation.

The preliminary engineering road designs sought to avoid and minimize impacts to wetlands whenever possible. A total of 41 individual wetlands would be affected. The total area of wetlands lost would be approximately 1.1 hectares (2.8 acres). The majority of these wetlands are classified as palustrine emergent wetlands, either saturated or seasonally flooded. Ten of these are thermally influenced wetlands totaling about 0.5 hectares (1.2 acres). The design and location of all but one new or relocated parking area/pullout would avoid wetlands. The total area of wetland mitigation for unavoidable impacts would be accomplished through restoration of a minimum of 1.1 hectare (2.8 acres).

Fisheries and Aquatic Resources. Environmental consequences due to implementation of Alternative B are expected to be similar in scope to those mentioned for Alternative A, except that stream channel migration should not occur due to the removal of rip-rap in the canyon area. Additional rip-rap and other structures would be required for the widening of the road through the canyon area. These structures and features could in the short-term increase sedimentation and turbidity during and shortly after construction.

Wildlife. The impacts on wildlife would be the similar to those under Alternative A except that habitat loss from construction would be less, approximately 24 hectares (59 acres), because of the narrower road width and the potential beneficial affects for bears of realigning the road out of a portion of the river/canyon bottom would not occur.

Air Quality. Impacts on air quality would be the same as described in Alternative A. They would be temporary and localized in nature and there would be only minor effects on park or regional air quality or visibility.

Threatened and Endangered Species. Potential impacts and mitigation measures would be the similar to Alternative A, other than the amount of habitat impacted would be less, approximately 24 hectares (59 acres), and the potential beneficial affects for bears of realigning the road out of a portion of the river/canyon bottom would not occur. This alternative would not be likely to adversely effect any threatened or endangered species.

Cultural Resources

Prehistoric Archeological Resources. Use of excess materials to create a berm between the Madison Campground and the edge of the road would not affect site 48YE365. Prehistoric components of 48YE867, eligible for the National Register of Historic Places, would be affected by construction activities and use for material stockpiling. A data recovery plan has been developed and approved, and was implemented in 1998 (see the discussion under Alternative A). With mitigation, the impact would not be adverse. Impacts would be less than in Alternative A since the road with would be 1.8 meters (6 feet) narrower.

48YE865 would receive no additional impact to site components contributing to eligibility.

Site 48YE866 could be affected by the project. However, because of the lack of integrity and subsurface deposits and the limited numbers and assortment of artifacts, site 48YE866 is not eligible for the National Register.

Historic Archeological Resources. The Iron Spring Quarry (48YE723) and the remnants of a possible structure, and artifact scatters have been determined eligible for the National Register. HAER recording of contributing elements of the site has been completed, so there would be no adverse effect on this site.

Impacts on site 48YE768 would be the same as described in Alternative A.

Several extant, abandoned roadbed segments may be affected by the project. However, these abandoned road segments do not contribute to 48YE520 (Grand Loop Road's) National Register eligibility, and they have already been documented.

To minimize potential resource impacts, areas affected by work at the Artists Paint Pots and proposed stockpiling at the Mesa Burn Pit 3 would be surveyed. If cultural resources are located, they will be documented, evaluated, and mitigating measures implemented as appropriate.

The Historic Roadway System. The Grand Loop Road Historic District and its contributing features (stone culvert headwalls, guard walls, retaining walls, etc.) are eligible for the National Register. Widening of the road and its structures would have an effect, but this does not meet the criteria of adverse effect. As described in the 1994 programmatic agreement among the NPS, SHPOs, and ACHP, all culverts have been documented using the List of Classified Structures (LCS) Single Entry Report and the Historic Building/Structures Survey Form. Completed documentation has been reviewed by the Wyoming SHPO who concurred that the park's survey responsibilities for structures described in the Programmatic Agreement are completed. In areas where the road has to be widened or culverts replaced, the culvert headwalls that retain integrity and are visible from the road or other visitor areas would be carefully dismantled and reassembled to preserve their historic appearance. Existing or similar materials would be used for new/rebuilt culverts, and the original design and quality of workmanship would be retained. All culverts and retaining walls in this road segment are in serious need of repair and some need to be replaced so the impact on the unnamed features for this alternative (24-foot road width) would not be much less than the impact of Alternative A (30-foot road width).

Sites 48YE807 and 48YE808, the Gibbon River Bridges Nos. 1 and 2, are contributing elements of the Grand Loop Historic District. The bridges would be resurfaced but would not need to be widened to accommodate the 24-foot highway. Rails would need to be redesigned to meet AASHTO standards. Replacement railings would be in keeping with the historic nature of the roadway. Over the year the bridge approach walls have sustained damage and will need to be repaired and rebuilt as necessary.

Ethnographic Resources. Affiliated tribes have been consulted, and there are no ethnographic resources identified in the project area. Therefore, there would be no effect on known ethnographic resources.

Cultural Landscape. The road is an integral part of the landscape. The cultural landscape in the vicinity of the highway would be impacted during and immediately following construction until vegetation has had a chance to fill in and rock cuts develop patina. Over the long term, the basic configuration and setting of the road would not be changed, and so no adverse impacts would occur. Somewhat less short-term disturbance would be expected under this alternative than in Alternative A.

Socioeconomic Environment

Impacts on the socioeconomic environment would be similar to those of Alternative A, except some safety problems, especially bicycle and motor vehicle conflicts from traveling in the same direction, would not be adequately addressed. Safety and traffic flow would not be enhanced as much as in Alternative A due to the narrower pavement width of Alternative B. Greater traffic congestion and likelihood of traffic interruptions or delays would persist, and restrictions on commercial bicycle tours would be required.

Also, in Alternative B, the dollar direct benefits from construction related expenditures such as purchase and transport of road-building materials and employment of construction workers would be less than that for Alternative A.

ALTERNATIVE C: NO ACTION

Natural Resources

Under the no-action alternative there would be no construction and no major surface disturbance on roadside slopes. Maintenance of the existing roadway and ditches would not likely disturb soils, vegetation, or geologic features on the slopes beyond ditches. However, persistent erosion/debris flows and associated maintenance/debris removal along the existing road through the Gibbon Canyon would continue to disturb adjacent thermal features, rare plant sites, wetlands, and water quality of the Gibbon River. There would also be continued degradation of resources from visitors using informal/undefined pulloffs along the roadway and from uncorrected erosion problems.

The existing road and traffic probably cause some displacement of wildlife and reduction of roadside habitat use, but this is difficult to measure. Most animals that are not hunted appear to habituate or become tolerant of regularly occurring, predictable

human presence. Traffic results in some inevitable road kills, but recorded incidences are low.

The potential always exists for human/grizzly bear interactions that would directly affect bears, such as vehicle accidents or habituation to human food sources from illegal feeding or available garbage. However, vehicle-caused grizzly deaths have been rare in the entire park and along this road, and current policies and enforcement seem effective in preventing human/grizzly problems along the roadway. Maintenance and use of the existing road are not expected to adversely affect grizzly bears.

Bald eagles, peregrine falcons, and gray wolves are found in the general vicinity, but there are no known effects on these species from the existing road or traffic, and no future effects are anticipated. Whooping cranes do not use the road corridor, so there would be no effects on cranes.

Cultural Resources

Prehistoric Archeological Resources. No new impacts would occur to prehistoric components of sites 48YE865 and 48YE867, both eligible for the National Register of Historic Places.

Historic Archeological Resources. No new impacts would occur to historic archeological resources.

Historic Roadway Resources. The Grand Loop Road Historic District, the two historic Gibbon River Bridges, and the roadway contributing features (stone culvert headwalls, guard walls, retaining walls, etc.) are eligible for the National Register. These features would continue to be negatively affected by erosion and deterioration due to age, weather, thermal activities, and vehicle impacts. The deterioration of this portion of the Grand Loop Road would result in some effect to the historic property.

Ethnographic Resources. Affiliated tribes have been consulted, and no specific ethnographic resources have been identified for the project area. Thus there would be no effect on known ethnographic resources.

Cultural Landscape. The Grand Loop is an integral part of the cultural landscape. In some areas, the landscape in the vicinity of the highway could be adversely impacted from use of unauthorized pullouts and subsequent erosion and loss of plant materials. Ongoing park maintenance may help mitigate these effects.

Socioeconomic Environment

Under this alternative there would be no construction-related disturbance of visitor traffic or of businesses inside and outside the park. However, the positive economic effects from road reconstruction work would not accrue to the regional economy.

Without road improvements visitors and staff would continue to be subjected to narrow, failing roadways and poor safety characteristics, including inadequate sight distances and inferior pulloffs. Frequent long delays and traffic congestion would persist. Continual, expensive, and yet inadequate maintenance activities would be required to keep the road open. These maintenance activities and debris slides would negatively

affect the visitor experience on an unpredictable basis. Accidents attributable to these conditions would increase and perhaps have more serious consequences. Driving and recreational experiences would be diminished by the deteriorating condition of the roads in the project area. Commercial bicycle tours would be prohibited. Visitor inconveniences and complaints would increase. Recreational activities along the existing roads would remain unchanged.

Park operations would continue to be adversely affected by the deteriorating road system. The road is expensive to maintain in its present state. High levels of traffic and increasing numbers of heavy vehicles (e.g., buses) would continue to damage the road surface and base material. Excessive flexing of base and pavement in thermal areas and wetlands, as well as the natural process of freezing and thawing, would exacerbate problems. Normal road maintenance would be required more frequently, and these activities would become more expensive and less effective as the present road surface and base deteriorated. Increased maintenance expenses for this road segment would continue to drain resources (funds, material, and personnel) from other park operations.

In some roadway sections, regular road maintenance would not be up to the task because the road would have become altered to the point where substantial improvement would be necessary. As the road continues to be negatively impacted, restrictions on the number, size, and/or type of vehicles may be necessary in the long-term. Eventually, maintenance could no longer prevent road failure. Continuing deterioration would result in road closures for safety reasons. Emergency road closures would cause unacceptable disruption of park operations and visitor travel plans. Lengthy closures might affect the local/regional tourism-related economy. West Yellowstone would be the gateway community most affected because of its proximity to the road segment in question.

In summary, continuing the current situation in the project area would not improve visitor experiences and would expose visitors, staff, and their property to increasing risk of injury and damage. Although the cost of road improvements would be avoided in the short-term, those savings would be achieved at the threat of major damage to life and property and much greater operational expenditures in the long run. On-going maintenance and safety problems would not be resolved.

COMPLIANCE STATUS

If the NPS regional director decided, based on the environmental assessment, that the project would significantly affect the human environment, a notice of intent (NOI) to prepare an environmental impact statement (EIS) would be issued. Conversely, a finding of no significant impact (FONSI) would be issued if it was determined that there would be no significant impact from this project. The FONSI would be approved by the regional director.

Consultation with the U.S. Fish and Wildlife Service on threatened and endangered species under 50 CFR Part 402, which implements the Endangered Species Act, would be completed. As part of the consultation process, the National Park Service would seek Fish and Wildlife Service concurrence with the environmental assessment's determination of effect on threatened and endangered species.

A section 404 permit from the Army Corps of Engineers, with concurrence from the Fish and Wildlife Service, would be required to comply with the Clean Water Act. This permit is required for discharge/placement of fill material into waters of the United States. A 401 certificate would also be required from the Wyoming Department of Environmental Quality.

Park roads are excepted from compliance with Executive Order 11988, "Floodplain Management," under NPS final implementation procedures as outlined in Special Directive 93-4, "Floodplain Management Guideline," July 1, 1993.

In compliance with Executive Order 11990, "Protection of Wetlands," a statement of findings (SOF) issued for impacts on wetlands would be prepared. The SOF would be approved by the regional director of the National Park Service. Wetland reclamation plans would be developed for all proposed reclaimed wetland sites.

A national pollution discharge elimination system (NPDES) permit for stormwater runoff would also be secured from the Wyoming Department of Environmental Quality before construction. The Storm Water Rule (Clean Water Act, PL 95-217, sec. 402) requires a NPDES permit on certain categories of stormwater discharge. Road reconstruction, which would involve clearing and grading activities that exceed 2 hectares (5 acres) on this particular road project, would require an NPDES permit.

All contractor activities would comply with state and federal air quality regulations, and contractors would operate under applicable permits.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires all Federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations or communities. The alternatives are not expected to result in major changes in the socioeconomic environment, and therefore it is not anticipated that any of the alternatives would result in direct or indirect disproportionately negative or adverse effects on any minority or low-income population or community.

Nomination forms for the Grand Loop Road Historic District (including the Madison to Norris highway) have been drafted for formal nomination to the National Register of

Historic Places. Because the roadway districts, including historic elements such as culverts and retaining walls, are eligible for the National Register, compliance with Section 110 and 106 of the National Historic Preservation Act is necessary. Section 106 compliance procedures for all the Yellowstone road projects began with the 1994 programmatic agreement among the Advisory Council on Historic Preservation, the National Park Service, and the Wyoming and Montana State Historic Preservation Officers. This agreement provides direction for protection and preservation of cultural resources during parkwide reconstruction and resurfacing of the Yellowstone National Park road system.

Most archeological sites within the area of potential impact have been inventoried, documented and tested. NPS recommendations for potential National Register eligibility were sent to the Wyoming SHPO, who concurred with NPS recommendations regarding determinations of eligibility on sites that might be affected by the project. Recent design changes at Artists Paint Pots necessitate an expansion of the inventoried area, and proposed use of the Mesa Burn Pit 3 would require additional inventory. Any resources identified will be evaluated in consultation with the Wyoming SHPO, and protective measures will be implemented as appropriate.

In accord with the programmatic agreement, a comprehensive treatment plan was developed for the evaluation and mitigation of archeological properties. This plan was reviewed by the Advisory Council on Historic Preservation, and the Wyoming and Montana State Historic Preservation Officers during the summer of 1993. The archeological sites that could be affected by construction were evaluated under the guidelines established in this document. Historic roadway features have been inventoried and documented as described in the 1994 programmatic agreement.

Sections of this environmental assessment itemize cultural resources inventories and documentation done in support of the project. The environmental assessment also contains a listing of further compliance needed, including inventory of the Artists Paint Pots area (table 2). This environmental assessment will be sent to the Advisory Council and the Wyoming State Historic Preservation Officer for their review and comment, and the document will provide data concerning overall project effect. Project designs and description for each of the three segments of the Madison to Norris undertaking will be submitted to the Wyoming SHPO and ACHP for review, comment, and concurrence of effect.

In late 1995 Native American tribes traditionally associated with Yellowstone National Park, including tribes listed in the 1994 programmatic agreement, were contacted. No ethnographic concerns or sites were identified within the area of potential effects.

CONSULTATION AND COORDINATION

SUMMARY OF SCOPING COMMENTS

Public comments were solicited on the project between August 7 and September 11, 1995. A total of 12 comment letters were received by October 10, 1995. Letters were received from the Wyoming Governor's Office, the Army Corps of engineers, the U.S. Fish and Wildlife Service, Montana Power Company, and eight individuals.

No new or unknown issues or alternatives were raised by the respondents. Many opinions were expressed about the realignment alternatives, parking areas, road closures, and protection of the geothermal features along the road. segment. Three respondents specifically requested that a road 30-feet in width be built, while four respondents specifically requested a road 24-feet in width be built. Many respondents expressed support for some or all of the realignment alternatives, however, an amphibian researcher strongly opposed any realignments due to the unforseeable effects on wildlife.

AGENCIES/ORGANIZATIONS CONTACTED

Advisory Council on Historic Preservation
Wyoming State Historic Preservation Office
West Yellowstone Chamber of Commerce
Jackson Hole Chamber of Commerce
U.S. Army Corps of Engineers
U.S. Forest Service
U.S. Fish and Wildlife Service
Federation of Fly Fishermen
Greater Yellowstone Coalition, Bozeman
Montana Audubon Council, Helena
National Parks and Conservation Association, Rocky Mountain Region
National Wildlife Federation, Missoula
Sierra Club, Wyoming Chapter
Teton County Certified Local Government
The Wilderness Society, Bozeman
Native American Tribes
- Crow
- Arapahoe (Fort Washakie)
- Shoshone (Fort Washakie)
- Confederated Salish and Kootenai Tribes
- Blackfeet
- Nez Perce
- Shoshone and Bannock Tribes at Fort Hall
- Northern Cheyene

APPENDIX A: VEGETATION MANAGEMENT FOR CONSTRUCTION IN YELLOWSTONE NATIONAL PARK

Revegetation efforts within the park have focused on careful management of topsoil as the only available growing medium and seed source. This is based on a park policy that seed obtained from sources outside the park would contaminate the park gene pools. Although it is a conservative method, the topsoil management approach has worked well.

The park has an interagency agreement with the Bridger Plant Material Center to assist in the formation of a park seed bank. The park has also tested mulches and can make this information available upon request.

All construction work within the park involving ground disturbance will meet the following criteria for revegetation accepted by the park.

1. All construction will be limited to that area necessary to complete required work. No activity, including vehicle or material use or storage, will be allowed outside the predetermined zone. If vehicles are to be traveling through an area numerous times, the same tracks will be used to prevent compaction in other areas. Compacted zones will be treated (raking, aerating, and replacement of topsoil) to assist revegetation. Topsoil will not be driven on at any time.

2. Excavation and improvement will be handled in manageable sections that reflect changes in the soil and vegetation. Trenching routes and disturbance zones will be flagged and approved by the park. All flagging and debris will be removed from the area after work is completed.

3. Sections will be rehabilitated as soon as possible. Topsoil will not be stockpiled over the winter or for longer than three months in sagebrush/rabbitbrush zones or longer than six months in grass-dominated zones. Any deviation must be approved by the park.

4. Topsoil refers to the uppermost soil horizon; it is usually found in the top 2 to 6 inches. Topsoil will be removed and replaced from the same area. Care will be taken to ensure that topsoil and fill material are not mixed and are stockpiled in separate areas (e.g., topsoil to the right of the trench and fill to the left).

5. Vegetation over 3 feet in height will be removed before the removal of topsoil and in a manner that least disturbs the topsoil. Topsoil will not be driven on, gouged, or compacted as vegetation is removed. Topsoil will be removed before stumps are pushed. Any deviation from this process must be approved by the park.

6. After large trees are removed, topsoil will be removed from an area in a single cut, including any vegetation that is 3 feet tall and under. Grubbing is not permitted.

7. Irregular land surfaces are recommended for a natural effect. Some rock outcropping and boulders may be left in place to create natural pockets for revegetation (see number 11). Deadfall snags may be stockpiled for later use on slopes that are very steep to provide catch points for soil.

8. Topsoil will not be used as bedding material. Separate bedding material will be obtained from sources approved by the park.

9. Topsoil will be replaced on site in a mixture of topsoil and vegetation associated with the topsoil and will be reworked over the site in a manner that preserves the seed source while spreading the soil over the area.

10. No topsoil will be imported from outside the park or moved internally within the park unless approved by the park. Any imported fill will be checked for exotic plants.

11. Trees and shrubs will be avoided if possible during trenching or excavation. Any trees removed during construction will be removed from the site unless specified by the park.

12. If replacement seed is required for revegetation in an area, the park will provide seed at cost to the contractor. Advance notice of six months to one year is required on projects exceeding 1,000 square feet.

13. Boulders unearthed during construction may be reburied or left exposed (with lower third buried) depending upon the location and extent of rock naturally occurring in the area.

14. If a trench is required, the surface of the trench will be left mounded to allow for settling along the line.

15. If mulch is required in sensitive areas due to visibility or exotic plant infestation, the park will specify the type and depth of mulch to be used. Nitrogen may be added in small quantities to any wood product used on slopes to balance nitrogen lost through decomposition.

16. No fertilizer will be used in any revegetation work unless requested by the park.

17. If relocated due to road reconstruction, junction boxes or cans will be placed in the field and approved by the park. Locations should be well screened by vegetation, topography, or large boulders.

18. All access to the site and stockpiling or staging areas will be identified by the contractor and approved by the park. These areas will be revegetated using approved techniques upon completion of the project.

19. All debris will be removed from the site to an approved pit or hauled away as approved by the park.

20. Final review and inspection will be made by the park before the work is accepted.

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As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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